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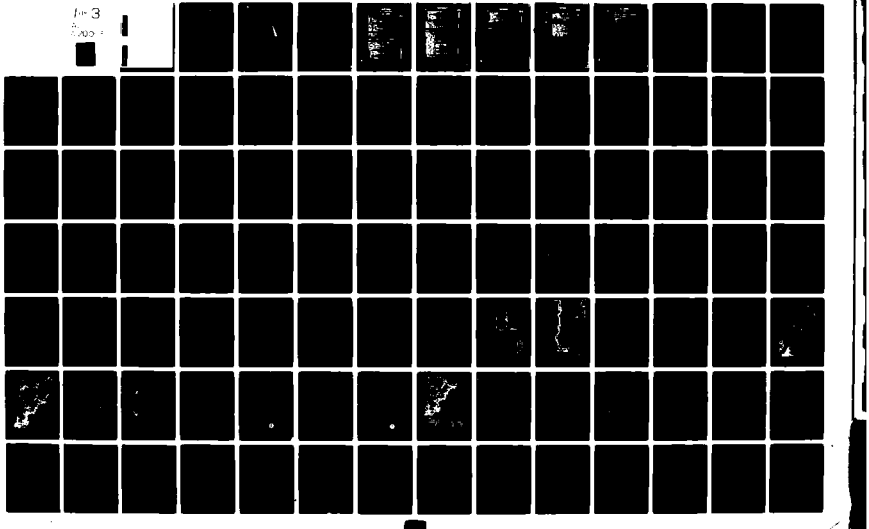

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report presents the results of a detailed engineering and economic feasibility study of providing winter anchorage area for commercial fishing craft in the Saco River at Camp Ellis Harbor, Saco Maine. Findings indicated that an icebreaker structure was necessary.

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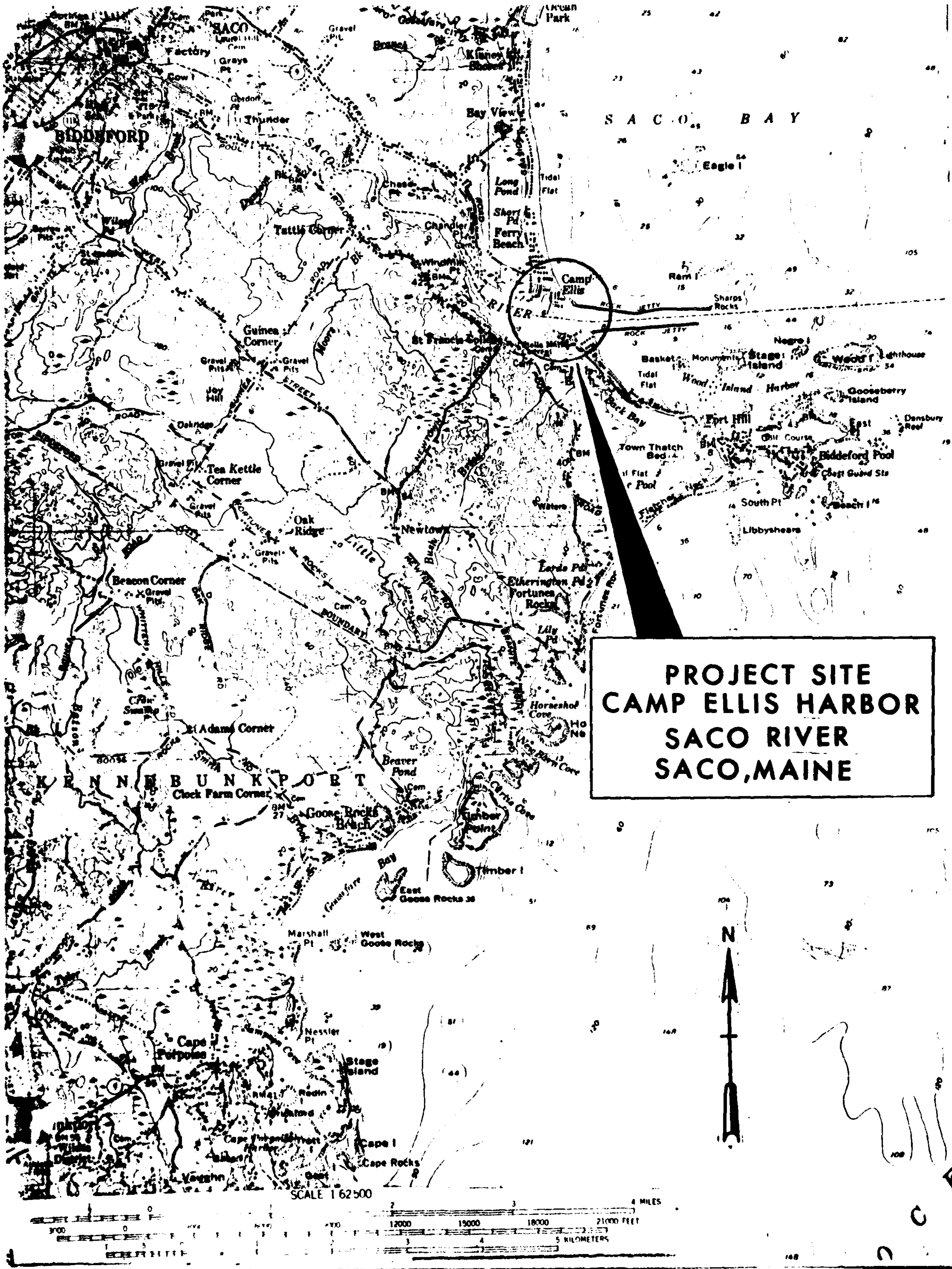
PROJECT SITE
CAMP ELLIS HARBOR
SACO RIVER
SACO, MAINE
SACO BAY
SACO
BIDDEFORD
KENNEBUNKPORT
Camp Ellis
Eagle I
Ram I
Stage Island
Wood Island Harbor
Fort Hill
Biddeford Pool
Gooseberry Island
Timber I
East Goose Rocks
West Goose Rocks
Cape Porpoise
Stage Island
Cape I
Cape Rocks
Goose Rocks Beach
Beaver Pond
Adams Corner
Beacon Corner
Tea Kettle Corner
Guinea Corner
Newtown
Oak Ridge
Tattle Corner
Bay View
Ferry Beach
Long Pond
Fortunes Rocks
Horseshoe Cove
Clock Farm Corner
Vaughn
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N
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4 MILES
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SYLLABUS

This study investigated navigation needs in the Saco River at Camp Ellis Harbor, Saco, Maine, to determine the feasibility of providing navigation improvements for commercial fishing vessels.

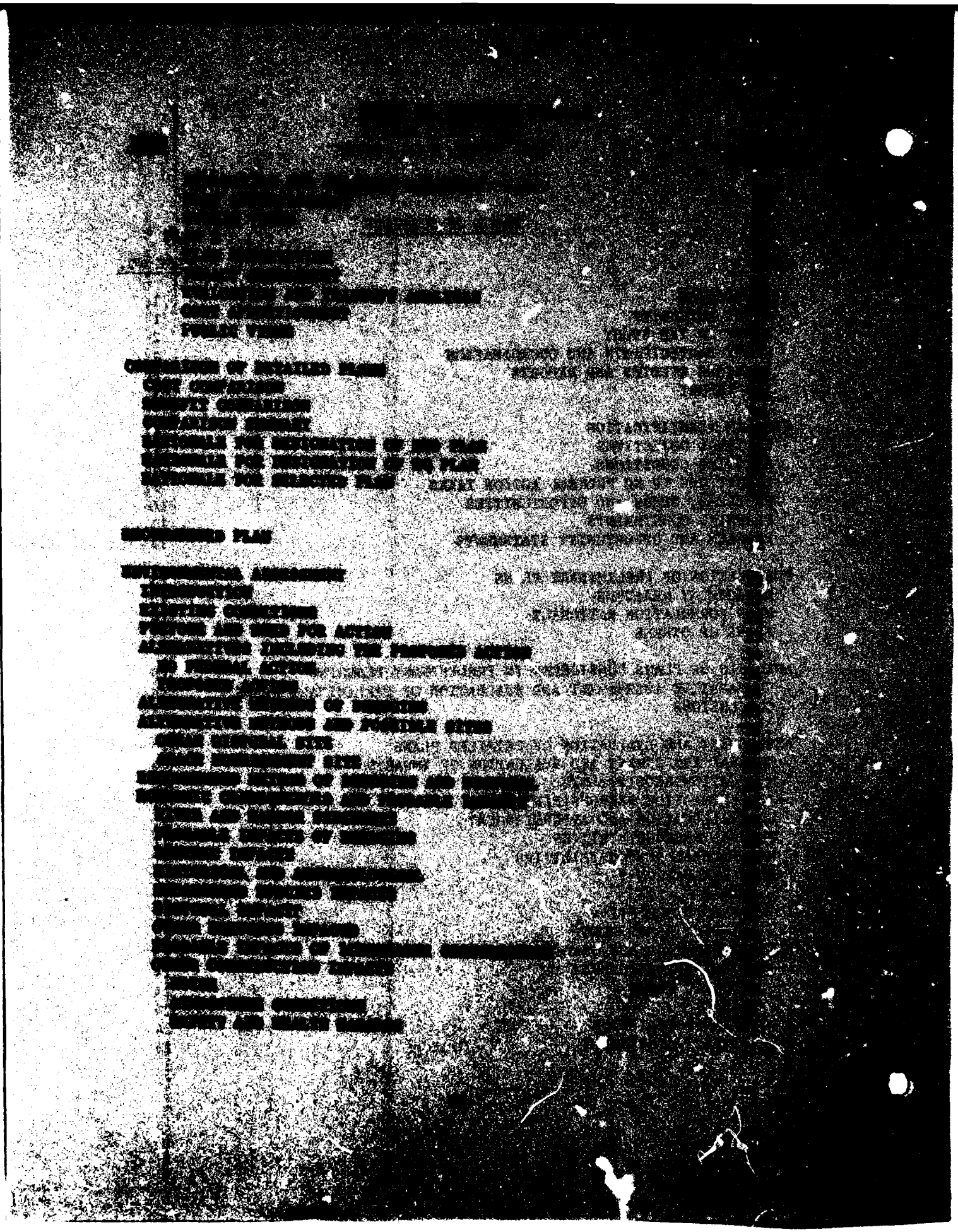
The paramount need identified is the protection of the harbor from ice floes in the Saco River. The provision of adequate navigation facilities will allow the city of Saco to utilize its water resources on a full-time, year-round basis.

Four alternatives were identified in an attempt to find the optimal plan of improvement to meet the present and future needs of commercial fishing activities. Alternatives identified as possible solutions included providing ice floe protection to the existing north Federal anchorage with a jetty or icebreaker structures or establishing a new downstream anchorage protected by a series of icebreaker structures. Evaluation of the alternatives indicated that the optimum plan of improvement at this time consists of dredging a 3-acre 6 foot deep anchorage protected by a series of 11 icebreaker structures, to be located to the east of the existing city pier and adjacent to the existing Federal navigation channel in the Saco River as well as two icebreaker structures to be located to the west of the city pier and placed to protect that structure.

Based on projected waterway use, the selected plan is economically justified. Total cost would be $237,700. Annual charges of $29,000 when compared to annual project benefits of $121,700 yield a benefit-cost ratio of 4.2 to 1. Due to the commercial nature of the project, the cost would be borne totally by the Federal government.

It is anticipated that maintenance of the anchorage will be required every 6 years, and replacement of the icebreakers will be required every 25 years. Maintenance of the project will be a Federal responsibility contingent upon the availability of maintenance funds, the continuing justification of the project, and the environmental acceptability of required maintenance activities.

The Division Engineer recommends that, subject to the conditions of non-Federal cooperation outlined in this report, the foregoing plan of improvement to the Saco River at Camp Ellis Harbor, Saco, Maine, be adopted.



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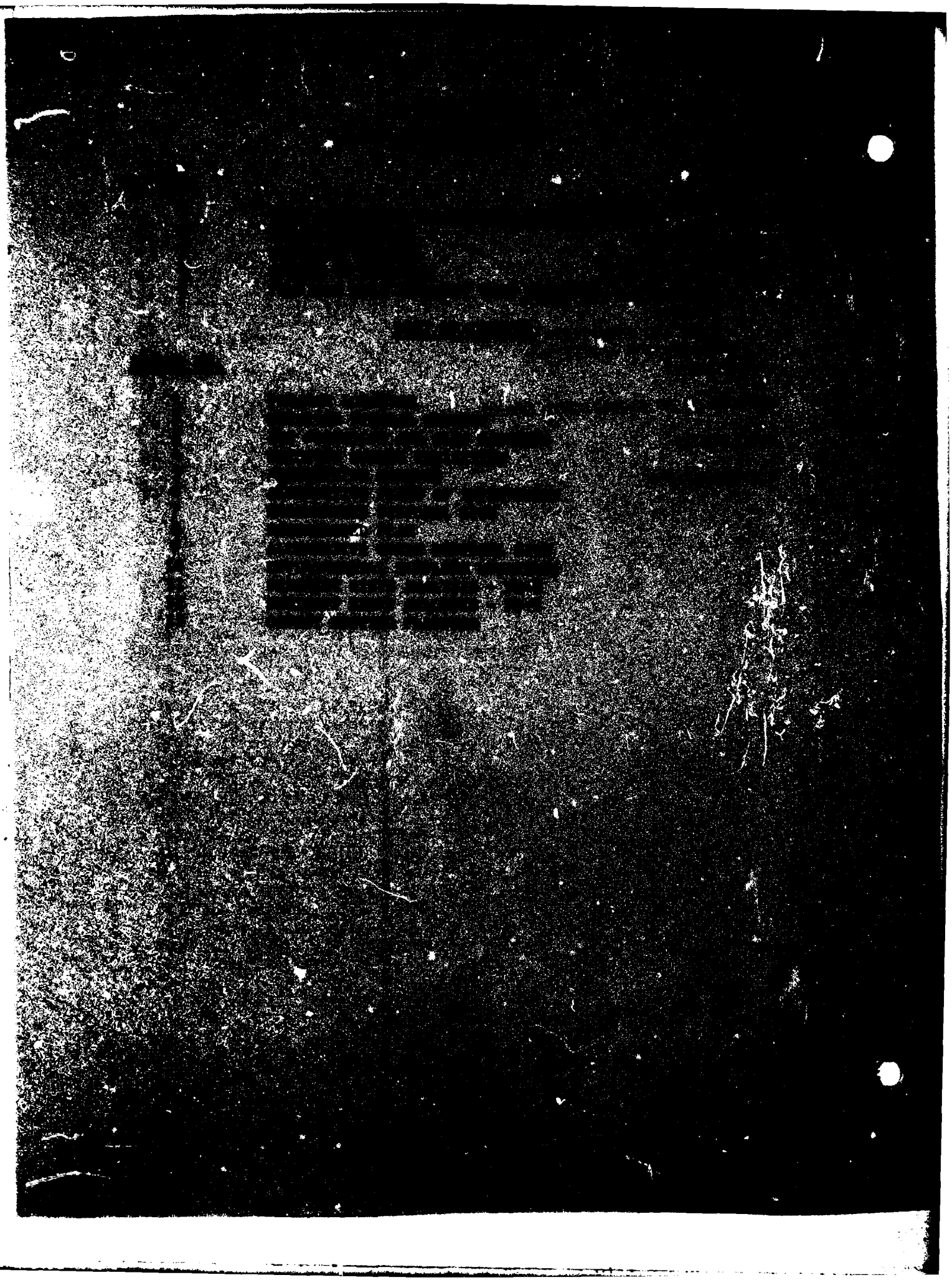

WATER RESOURCES IMPROVEMENT PROJECT
SACO RIVER - CAMP ELLIS HARBOR
SACO, MAINE

DETAILED PROJECT REPORT

INTRODUCTION

This report presents the results of a detailed engineering and economic feasibility study of providing a winter anchorage area for commercial fishing craft in the Saco River at Camp Ellis Harbor, Saco, Maine. The Saco River originates at Crawford Notch in the White Mountains of New Hampshire and flows southeasterly through Maine to a termination separating the cities of Saco and Biddeford on the Atlantic coast. The mouth of the river forms Camp Ellis Harbor as shown in Figure 1. The Saco River is tidal and navigable for a distance of approximately 6 miles from the open sea and extensively used for commercial and recreational boating.

Commercial fishermen who conduct fishing operations during the winter months need a sheltered anchorage to protect their boats from ice damage. Ice flowing through the existing Federal anchorage can be extremely damaging to moored vessels, forcing most fishermen to haul their boats ashore for the winter months or relocate to another harbor for the winter at considerable expense. The provision of a protected winter anchorage area at Camp Ellis will allow year-round utilization of existing facilities and afford local fishermen the opportunity to maximize the efficiency of their operations.

Recognizing the needs of local fishermen, the city of Saco requested that the Corps of Engineers study the feasibility of providing an anchorage protected from winter ice floes.

In a letter dated 6 July 1976, the city of Saco concurred with the findings of a Reconnaissance Report prepared by the Corps of Engineers recommending that a detailed study of possible improvements be undertaken.

This Detailed Project Report is the final product of that detailed study and outlines the study process, presents all facts and data that were considered during the course of the study, and presents the plan of improvement recommended for implementation by the Corps of Engineers.

STUDY AUTHORITY

This study was initiated by the New England Division of the U.S. Army Corps of Engineers at the request of the officials of the city of Saco. It was prepared under the provisions of Section 107 of the 1960 Rivers and Harbors Act, P.L. 86-645, as amended.

SCOPE OF THE STUDY

The scope of this study includes the preparation of a Detailed Project Report consisting of:

1. Determining the navigational needs of the study area.

2. Identifying navigational opportunities in the study area.

3. Formulating alternative anchorage improvement plans that meet identified area needs and promote identified opportunities.

4. Evaluating and comparing the economic, social and environmental impacts of the alternative plans.

5. Determining if improvements are feasible and, if so, recommending improvements to anchorage facilities that are economically feasible, socially beneficial and environmentally acceptable.

Although this study is primarily oriented toward commercial fishing operations, the needs of recreational boaters in the Camp Ellis area were also considered.

The geographical scope of this study is generally limited to the Saco River at Camp Ellis Harbor. In those instances where project impacts extend beyond the study area, these impacts are fully evaluated in general terms.

STUDY PARTICIPANTS AND COORDINATION

The preparation of this report required close cooperation between the Corps of Engineers, the Saco City Council, officials of State and local government, local commercial fishermen, businesses, associations, and interested individuals.

The needs for navigation improvements were outlined in a preliminary study report dated September 1976, and a favorable response received from the Chief of Engineers authorized the New England Division to proceed with this report.

PREVIOUS STUDIES AND REPORTS

Federal. A number of reports have been prepared by the Corps of Engineers resulting in navigation improvements in the Saco River and Camp Ellis Harbor area. The existing Federal navigation project, as shown in Figure 2, includes an access channel, 8 feet deep, extending from the sea to the head of navigation at Saco and Biddeford, a distance of 6 miles. The width of the access channel ranges from a minimum of 100 feet to a maximum of 200 feet. There have been several structures constructed in the river. These are (a) several small riprap jetties; (b) a riprap

breakwater about 6,600 feet long extending seaward from the north side of the river mouth; and, (c) a riprap jetty about 4,800 feet long extending from the south side of the river mouth, about parallel with the breakwater. The most recent improvements, completed in 1969, include two anchorages at the river mouth totaling 10.5 acres in area and a 10-acre maneuvering basin at the head of navigation, all to a depth of 6 feet. A detailed list of Federal reports on navigation are presented in Appendix 1.

Other Studies. A draft report for improvement of the Camp Ellis fish pier facility was completed in 1980. This report, sponsored by the Coastal Program of the Maine State Planning Office, is a study of alternatives for enlarging the existing pier to allow for docking at all stages of the tide. The report is titled Engineering and Design Considerations for Improvement of the Camp Ellis Fish Pier Facility.

A report titled A Study of Beach Processes and Management Alternatives for Saco Bay was prepared and released by the Maine State Planning Office, in 1979. The report describes the components of the Saco Bay system and their responses to natural forces and investigates the effects of man's activities on the system. It also makes some management recommendations and options for utilizing the beach system.

A report on Sediment Distribution and Hydrodynamics of the Saco River and Scarboro Estuaries was conducted in 1970 by the Department of Geology at the University of Massachusetts.

THE REPORT

This Detailed Project Report consists of a Main Report and supporting appendices. The body of the Main Report is structured in accordance with the planning process followed during the course of the study. It is organized as follows: Problem Identification, Formulation of Preliminary Plans, Assessment and Evaluation of Detailed Plans, Comparison of Detailed Plans, and an Environmental Assessment.

The report has five appendices: Appendix 1, Problem Identification, supplements the material in the first part of this report. Appendix 2 addresses the formulation, assessment and evaluation of alternative plans. Appendix 3 summarizes public views and responses. Appendix 4 describes the engineering data and analyses to support the design and cost estimates. Appendix 5 contains the economic analyses.

PROBLEM IDENTIFICATION

This portion of the report sets forth the nature and scope of the problems necessitating channel improvements, and establishes the planning objectives and constraints that give direction to subsequent planning tasks.

NATIONAL OBJECTIVES

Planning for channel improvements in the Saco River at Camp Ellis Harbor is based on the national objectives of National Economic Development (NED) and Environmental Quality (EQ) as set forth in 1980 by the National Water Resources Council in Principles and Standards for Planning Water and Related Land Resources. The purpose of the Principles and Standards is to promote the quality of life by planning for the attainment of the following national objectives:

NED Objective. To enhance national economic development by increasing the value of the nation's output of goods and services and by improving national economic efficiency.

EQ Objective. To enhance the quality of the environment by the management, conservation, preservation, creation, restoration or improvement of certain natural resources, cultural resources and ecological systems.

EXISTING CONDITIONS

The Saco River originates in the White Mountains of New Hampshire and flows southeasterly through Maine to a termination separating the cities of Saco and Biddeford on the Atlantic Coast. The drainage area is 1,697 square miles and the mean discharge at the mouth is 3,200 cubic feet per second. The mouth of the river forms Camp Ellis Harbor, a tidal inlet navigable to the cities of Saco and Biddeford, approximately 6 miles upstream. The city of Saco lies approximately 16 miles southwest of Portland. The location is shown on National Ocean Survey Charts numbered 13286 and 13287 and the U.S. Geological Survey topographic quadrangle titled Biddeford, Maine.

The city of Saco, located on the northern bank of the river has experienced moderate population growth since 1960. In that year, the U.S. Census listed 10,515 residents, compared with 11,678 in 1970, an increase of approximately 11.0 percent in that decade. This growth greatly exceeds the corresponding increase for the State of Maine (2.5%) and is only slightly less than that of New England as a whole (12.7%). In 1980, the population of Saco was 12,933, an indication that growth has continued during this decade at approximately the same rate, and population projections reflect a continuation of this moderate growth trend.

The cities of Saco and Biddeford are the principal cities on the Saco River. They constitute the largest industrial, commercial, banking, shopping and service trade center in York County. The area serves as a focal point for manufacturing activities, while fishing and recreational businesses contribute significantly to the overall economy. Eighty percent of manufacturing production for southern Maine takes place in the Biddeford-Sanford Economic Area. Principal industries in York County produce transportation equipment, leather goods, rubber and plastics, textiles, electrical equipment, lumber and wood products, and machinery and ordinance.

Much of the seasonal employment and income in Saco is associated with recreational and commercial activities at Camp Ellis Harbor. The existing Federal anchorages currently provides mooring for 75 boats, 45 of which are commercial fishing boats and 30 of which are recreational vessels. The demand for additional mooring at Camp Ellis was somewhat satisfied through the completion of a maintenance dredging project in late 1978 that returned the anchorage to its authorized boundaries. However, expansion of those boundaries would be necessary to satisfy the total excess demand. Both fishing and recreational craft complete for space at the harbor.

Camp Ellis Harbor enjoys many natural locational benefits, with easy access to the open sea and a proximity to the finest and most frequently used lobster beds off the Maine coast. Local fishermen choose the harbor as their preferred anchorage site, despite the expected problems encountered in the winter season, because the travel distance to these prime fishing grounds is shorter than from any of the alternative anchorages. This is a particularly important asset during the winter months when seas are characteristically rougher and the air temperature generally well below freezing. The breakwater and jetty have provided adequate wave protection in the Saco River and continued maintenance dredging of the channel has allowed problem-free access regardless of tidal conditions. This latter advantage is one not shared by the nearest alternative anchorage at Biddeford Pool, where the natural entrance channel is almost unnavigable at low tide. Camp Ellis is also convenient to major regional wholesale distributors, which in turn find a ready market in local residents, tourists, restaurants, and retail stores all over the northeastern United States.

The major commercial activity at Camp Ellis Harbor is lobstering. Finfishing is also of importance with the catch primarily consisting of haddock, cod, and pollock. The peak lobstering season occurs during the months of August, September and October, and the low point occurs from January through April. Fishermen cite the migratory habits of the lobsters as the major reason for the seasonal nature of the industry for during the winter months the lobsters migrate to deeper water. Severe weather conditions generally render the extra travel time involved in reaching the lobsters and the additional problem of trapping them at a greater depth unacceptable to most lobstermen.

Because of the difficulties encountered in lobstering during the cold winter months, the major commercial activity at Camp Ellis Harbor from December to March becomes finfishing, which does not require as great a travel distance. It is estimated that at least half of the annual finfish catch of approximately $375,000 occurs during the four month period. The gross haul of fish at Camp Ellis Harbor does not approach its potential total, however, because inadequate facilities in the harbor force most fishermen to haul their vessels ashore and remain idle, or relocate to nearby harbors, including Biddeford Pool, Cape Porpoise, Kennebunkport, Pine Point, or Portland. The near-termination of commercial activity at Camp Ellis during the winter is the result of extensive damage to vessels from large sheets of ice which form in the predominantly fresh water upstream, break away, and follow the current downstream into the anchorage site. Many of these ice flows weigh up to 40 tons and have been observed traveling through the anchorage in excess of 100 feet per minute cutting deep into wooden vessels upon collision. This sheet ice trends to form both above and below the narrows at Windmill Point (see Figure 3). It has been observed that certain weather conditions are required to form this ice. Generally, the ice forms at the end of the incoming tide with minimum wind conditions and an ambient air temperature of less than 15°F. Because the air temperature has to be so low, the formation of ice usually occurs late at night or in the early morning during the last hours of an incoming tide. During the incoming tide the fresh river water with a lower density and higher freezing point "floats" over the heavier salty tidal waters and freezes. Because the ice is formed from fresh water it is very hard and rigid.

As shown in the ice formation and movement diagrams found in Appendix 4, ice forms in the Windmill Point area, breaks off, and floats downstream to the ocean. Sheet ice also forms along the riverbanks in and above the city pier in areas where fresh water is available in sufficient quantities to allow the formation of sheet ice. On the south bank of the river sheet ice usually forms from the vicinity of Jordan's Point upstream and on the north bank of the river sheet ice forms from the city pier upstream along the shoreline and out into the existing Federal anchorage areas.

This type of ice, has been the biggest problem to the commercial fishing fleet. The edge of the sheet acts as a saw; cutting, splintering and tearing at a vessel's water line. As the thin ice cuts into the boats, it breaks and forms a new sharp cutting edge that can cause further damage. In addition, the momentum of the relatively heavy sheets can cause a crushing effect. The extent of damage to vessels has varied from splintering and abrasion to cutting and sinking.

Several fishermen have tried to protect their boats by installing copper or fiberglass sheathing along the waterline. This method has not proved to be entirely satisfactory in many instances, because the ice has either cut or torn away the sheathing.

During the winter of 1976-1977, only three vessels remained active in Camp Ellis Harbor, all of which suffered major structural damage. The following winter, 1977-1978, eight vessels remained active, one of which sank (resulting in an estimated loss to the owner of $2,500) and seven of which required an average of $250 in repairs in excess of the normal annual maintenance costs. The harbormaster maintains that six vessels are expected to remain active during a typical winter season, and that few, if any, escape structural damage.

During the peak summer and fall months, the 45 commercial vessels in the harbor provide approximately 75 full-time jobs and 15 part-time jobs. During a typical winter season, commercial fishing at Camp Ellis provides only about 18 full-time jobs. Many fishermen maintain a steady income flow by operating out of alternative ports, but many others find it financially disadvantageous to do so because of the additional costs involved in relocation.

The predominant land use along the Saco River from Saco-Biddeford to the sea is residential. Virtually all industrial land uses in both cities are located on either side of and on Factory Island. Other industrial areas are located in existing industrial parks in Biddeford (Alfred Road Park, Biddeford Industrial Park, Biddeford Airport Industrial Park, and the proposed Airport Industrial District) and in Saco (Saco Industrial Park). Commercial land uses are centered in the downtown district of both cities, although there is considerable commercial strip development along Rtes. 1 and 9.

There is less development along the Saco side of the river as a result of topography and the marsh areas located there. However, new residential growth is occurring along Ferry Lane. New growth is also evident in the Camp Ellis area. Thunder Island is a large stretch of undeveloped land which is currently protected under the Maine open space tax plan. Camp Ellis is the site of many older vacation homes.

As a result of growth in second homes and the area's increasing popularity, Hills Beach, Fort Hill, Biddeford Pool, and Fortunes Rock have evolved into higher income enclaves. This change to higher income housing is also evident in Camp Ellis.

The climate of the river valley is subject to two major influences, the White Mountains and the Atlantic Ocean. The Atlantic Ocean has a moderating influence, cooling in the summer, and warming in the winter. Mean temperatures for January 1976 was 19.5^{o}F and for July 1976 was 70.4^{o}F. Precipitation is fairly well distributed throughout the year with 1976 mean precipitation (Saco) of 45.14 inches. The freeze free period at Saco was 181 days. Climatological data (30 year means) are not available for Saco-Biddeford, so Portland data will be presented for the area's mean wind speed (8.8 mph) and prevailing direction (southerly).

This section of Maine is located in the seaboard lowland province, a subsection of the New England physiographic province. The estuarine basins of the area have originated by the drowning of river valleys and are usually segregated from open water by large barrier islands or spits. At the mouth of the Saco, a small spit (Biddeford Pool-Hills Beach area) remains and is composed of coarse feldspathic sands. Beaches occur where surficial sediments exist below mean high water. The major sandy beaches (Ferry Beach, Hills Beach) occur where outwash sediments are reworked by ocean waves.

The Saco River estuary, from the river mouth to the tidewater dam in Biddeford-Saco, is a 6 mile channel with highly irregular bottom topography. The circulation pattern within the estuary is controlled by fresh water flows in the Saco River and by tidal currents. On each flood tide, a salt water wedge moves approximately four miles upstream pooling the freshwater discharge until the end of flood when the ebb current carries the lighter freshwater over the salt wedge toward the ocean. This estuary may be classified as a "horizontal to inclined salt wedge estuary" which exhibits a highly stratified salt gradient with salinity ranging from 0 to 30 parts per thousand (ppt). Deep pockets within the bedrock channel have been observed to collect the higher saline water from a flood tide and retain this salt water through an entire tidal cycle until it is mixed with the salt water of the next flood.

The mean flow in the Saco River as measured by the United States Geological Survey (USGS) at Cornish, Maine in 1976 was 3337 cubic feet per second (cfs). The maximum flow was 18,900 cfs, and the minimum flow was 765 cfs.

The tide at Saco is semidiurnal. The mean tidal range is 8.7 feet. Mean high tide is 8.7 feet above the mean low water level and extreme low tide is 3.5 feet below the mean low water level. Storm surges up to 12.0 feet above mean low water can be expected at least once or twice yearly.

According to the stream segment priority system developed by the Maine Department of Environmental Protection in 1976, the stretch of the Saco River from Bar Mills to the Atlantic Ocean, which includes the Saco River Estuary is listed as Class III. Class III waters are those which exhibit moderate water quality problems including localized problems associated with wastewater discharges. These problems can usually be eliminated with the application of conventional treatment, including solids and BOD removal, and chlorination.

The Saco River (from Saco-Biddeford to the sea) serves as a harbor for fishing vessels, yachts, and small pleasure craft.

There are four major marine facilities located on the Saco River. The location of available marine facilities on the Saco River is shown in Figure 4. A list of these facilities and their services is provided below.

1. Riverside Anchorage, Glenhaven Circle, Saco is a marina operation consisting of 110 slips. The marina has space to accommodate transients. Fuel and marine supplies are also available.

2. The Saco Yacht Club, Front Street, Saco, is the major private yacht facility on the Saco River. The Yacht Club has approximately 70 slips and 170 members. There are no immediate plans for expansion, although the facility is operating at capacity.

3. Rumery's Boatyard, Inc., 109 Cleaves Street, Biddeford, Maine is a combination marina-boat repair facility. Rumery's has 42 slips for rent. There is a mobilelift (12 ton, 40 feet) available on the premises. Inside storage is available for 50 boats and 24 boats outside. The boatyard custom builds vessels, repairs hulls and inboards, and sells marine supplies.

4. Meeting House Eddy is a 10 acre state administered boat access site located on the Saco River in Biddeford. This is the chief public boat launching site for the lower Saco River. The average daily use of the facility was 15 units on the weekends, and 17 units on the weekdays. Ninety percent of its use was generated from Maine residents.

5. The public dock at Camp Ellis is one of the most important docking facilities on the river. This dock is extensively used by lobster boats and commercial fishermen. The facility is also used by larger recreational boats. A public launching ramp is available on the west side of the Camp Ellis dock.

The area is served by U.S. Highway No. 1 and by Maine State Routes Nos. 5, 9, and 98. The Maine Turnpike (Interstate 95) is about one mile northwest of Saco. Rail transportation needs are provided by the Boston and Maine Railroad, which runs through the business district of Saco.

CONDITIONS IF NO FEDERAL ACTION TAKEN

Without the proposed project the winter anchorage conditions at Camp Ellis Harbor can be expected to remain essentially as they are today. The cost of providing all weather anchorage facilities at Camp Ellis without Federal assistance would probably be economically prohibitive to the city of Saco.

Without an ice free anchorage, fishing out of Camp Ellis Harbor during the winter months will continue to be a hazardous proposition. It is unlikely that the winter fishing fleet will expand or even continue in its present state unless improvements are constructed. If the improvements are not constructed the expected increase in fish landings and related marine employment during the winter months would not materialize.

If no Federal action is taken the city is expected to continue its efforts to expand and improve the existing city pier at Camp Ellis Harbor for the benefit of both recreational and commercial users during the existing navigation season.

PROBLEMS, NEEDS AND OPPORTUNITIES

The primary problem in the Saco River at Camp Ellis Harbor is the formation and movement of sheet and chunk ice along the river, especially through the existing Federal anchorages, during the winter months. Ice flowing through the anchorage can be extremely damaging to moored vessels, forcing most fishermen to haul their boats ashore for the winter months or relocate to nearby harbors, including Biddeford Pool, Cape Porpoise, Kennebunkport, Pine Point, or Portland. Studies have indicated that three types of ice (slush, chunk and sheet) occur on the Saco River.

1. Slush ice is made from saltwater and usually occurs on small formations of freshwater ice. This type is characteristically soft and spongy causing little or no damage.

2. Chunk ice, formed over a period of several days or weeks, begins to flow with an increase in temperature. When flowing, chunk ice can weigh from 5-200 tons and have a thickness of 1/2 to 4 inches. The sheer weight of the ice can crush vessels causing difficulties but its size minimizes any potential cutting or sawing effect.

3. Sheet ice forms in sheets 1/4 to 1/2 inch in thickness and weighs between 3 and 40 tons per floe. Similar to chunk ice, the weight of the floe can crush vessels in its path, but the major effect is the edge of the ice acting as a saw; cutting, tearing, and splintering a vessel at the waterline.

The need of the community as developed through the identification of its problems is to establish an ice free anchorage for year round commercial use.

Improving winter navigation at Camp Ellis Harbor would provide the following opportunities:

- increase the present fish landings
- offer additional employment
- encourage harbor facility development
- provide protection to the city pier from ice damage.

The opportunities to meet the needs cited above can best be met through close coordination and interaction during the entire planning phase of the project.

PLANNING CONSTRAINTS

Throughout the process of developing and selecting plans of improvement, every attempt is made to develop plans that solve the problems and fulfill the related needs of the study area. Before this process begins, consideration must be given to known constraints that can limit the options for solving the problems. Constraints can include natural conditions, economic limits, social and environmental factors and legal restrictions.

Through consultation with various public agencies, fishermen, and concerned individuals three issues have been identified as constraints in formulating alternative preliminary plans.

The first identified constraint is to minimize adverse impacts on the fish and wildlife in the study area. Restricting construction to the fall or winter months will avoid turbidity in the water column during the spring-summer spawning run of alewives and the summer spawning time of soft-shell clams. Also, most waterfowl and shorebirds will nest in the spring and summer.

The second constraint is to avoid any negative impacts on existing structures by designing proposed improvements on alignments that do not interfere with the structural integrity of existing structures.

The third and final constraint identified is to avoid any adverse impacts on the marine resources both within Camp Ellis Harbor and the surrounding waters.

In addition to the identified constraints, a concern was raised during the study and all attempts will be made to meet the steps necessary to comply with this identified concern. The identified concern is to avoid those measures that would increase the natural rates of erosion along the riverbanks.

In summary, the planning constraints as identified are:

* Restrict construction activities to the fall or winter months.

* Avoid negative impacts on the existing structures.

* Avoid adverse impacts on the marine resources both within Camp Ellis Harbor and the surrounding waters.

PROBLEM AND OPPORTUNITY STATEMENTS

Problem and opportunity statements for this study were developed after identifying and analyzing concerns regarding the use of water and related land resources in the study area. The purpose of the problem and opportunity statements is to direct the study effort in a manner that

addresses all identified concerns. This is accomplished through the translation of the identified problems, needs, and opportunities into specific planning objectives for the study. These problems and opportunity statements will be used in conjunction with planning constraints in the development of alternate plans that appropriately address study objectives and area needs. The establishment of clearly defined statements of the problems and opportunities in the study area is also essential in evaluating the various plans that have been studied. The relative merit of each plan is determined, in great part, by the extent to which it addresses and fulfills the problems and needs of the area as defined in the problem and opportunity statements.

Based on the discussion of problems, needs, and opportunities presented previously, four problem and opportunity statements have been formulated as important guidelines to formulation and evaluation of plans to meet the needs of the area.

- Contribute to the safe mooring of commercial fishing vessels at Camp Ellis Harbor through a reduction of ice damage sustained by the fleet during the 1981-2031 period of analysis.

- Contribute to the increased utilization of Camp Ellis Harbor by local fishermen in the winter months during the 1981-2031 period of analysis.

- Contribute to the preservation of adjacent beaches during the 1981-2031 period of analysis.

- Provide an increased degree of protection from ice damage to the wooden public dock at the Camp Ellis pier during the 1981-2031 period of analysis.

FORMULATION OF PRELIMINARY PLANS

Systematic consideration of the problems, needs, and opportunities led to the formulation of alternative preliminary plans. These plans, designed to achieve the objectives previously identified by the problem and opportunity statements were developed in light of the planning constraints. State and local objectives were also paramount considerations in the evaluation of alternative plans.

MANAGEMENT MEASURES

As the basis for formulating alternative plans, a broad range of management measures can be identified to address one or more of the problem and opportunity statements. Management measures can generally be categorized as either structural or nonstructural.

Structural measures would generally involve construction of features which would permit year round utilization of Camp Ellis Harbor and the city pier. Nonstructural measures could involve transferring fishing activities during the winter months to another harbor that offers adequate protection and capacity.

The primary nonstructural solution for the Camp Ellis Harbor fishing fleet is to transfer existing commercial operations to other nearby ports during the winter months. The alternative ports most frequently used by Camp Ellis Harbor fishermen are Biddeford Pool, Kennebunkport, Cape Porpoise, and Pine Point. The location of these ports relative to Camp Ellis is shown in Figure 5.

Camp Ellis Harbor enjoys many natural locational benefits, with easy access to the open sea and a proximity to the most frequently used lobster beds off the Maine coast. Local fishermen choose the harbor as their preferred anchorage site, despite the expected problems encountered in the winter season, because the travel distance to these prime fishing grounds is shorter than from any of the alternative anchorages. This is a particularly favorable asset during the winter months when seas are characteristically rougher and the air temperature generally well below freezing. The breakwater and jetty have provided adequate wave protection in the Saco River and continued dredging maintenance of the channel has allowed problem-free access regardless of tidal conditions. This latter advantage is one not shared by the nearest alternative anchorage at Biddeford Pool, where the entrance channel is almost unnavigable at low tide. Storm conditions make entry into Biddeford Pool hazardous due to the alignment of the entrance channel. In addition, Biddeford Pool has limited anchorage and unloading facilities.

Biddeford Pool, Cape Porpoise and the Kennebunk River are all Federal navigation projects. The Kennebunk River and Cape Porpoise Harbor, currently heavily utilized by commercial craft, are the subject of an ongoing Federal navigation improvement study. The town of Kennebunkport

recently voted funds to participate in the construction of a State-sponsored commercial pier at Cape Porpoise. Local officials in Kennebunkport are optimistic that improved facilities at Cape Porpoise will reduce congestion in the Kennebunk River by allowing transfer of some commercial craft to the new facility. Development of the ports of Cape Porpoise and Kennebunkport beyond those improvements currently planned to increase the efficiency of the existing commercial fleets at these ports is considered remote due to economic and physical limitations. The limited facilities and ice formations in the Scarboro River at Pine Point do not lend themselves to the support of a major winter fishing fleet. Further development of Pine Point in support of an enlarged commercial fleet during the winter months is considered unlikely. Therefore, as an alternative to structural protection of Camp Ellis Harbor, transferring of existing craft has been eliminated from further consideration because sufficient capacity does not exist in nearby ports and none is anticipated in the near future. Further data on non-structural solutions is found in Appendix 2.

Based on the above considerations, it was decided to analyze structural solutions to solve the present problems in Camp Ellis Harbor.

Structural solutions would generally involve construction of features that would permit year round utilization of Camp Ellis Harbor and the city pier. The structural measures could involve either protecting an existing Federal anchorage with ice-breaking and/or ice-deflecting structures or construction of a new anchorage with suitable structures to break or deflect ice floes.

PLAN FORMULATION RATIONALE

The formulation of plans of improvement for the Saco River at Camp Ellis Harbor are predicated on a standard set of criteria adopted to permit the development and selection of a plan which responds to the problems and needs of the area. Each alternative was considered on the basis of its contribution to the planning objectives.

Selection of a specific plan for Camp Ellis Harbor is based on technical, economic, and environmental criteria which would permit a fair and objective appraisal of the consequences and feasibility of alternative solutions.

Technical criteria requires that the optimum plan should have facilities and dimensions adequate to accommodate expected user vessels and have sufficient areas both for the maneuvering of boats and the development of shore facilities.

Economic criteria specify that tangible benefits should exceed economic costs and that the scope of the project is such as to provide maximum net benefits.

Environmental criteria involve utilizing available sources of expertise to identify endangered species of marine life. Furthermore, the use of natural resources to affect plan utilization as well as adverse social impacts should be minimized. Environmental criteria require that activities attracted to the area after plan implementation should be consistent with activities of the surrounding area, and that said activities be environmentally acceptable. The selected plan should incorporate measures to preserve and protect the environmental quality of the project area. Finally, both plan formulation and implementation should be coordinated with interested Federal and non-Federal agencies, local groups, and individuals through cooperative efforts, conferences, public meetings, and other procedures.

PLANS OF OTHERS

The city of Saco plans to construct improvements to its pier in the Saco River at Camp Ellis harbor regardless of the final findings on the Federal improvement proposal. It is unlikely that the city would also be able to provide the necessary capital to construct navigation improvements or any other protection structures.

It is unlikely that State funding for dredging at Camp Ellis Harbor would be made available. State participation in the pier improvements is being studied at this time by the Maine Department of Transportation. It is not expected that any further funding would be provided the city of Saco.

Of all the non-structural alternatives identified to date, none have adequately met the full range of local planning objectives as expressed in the problem and opportunity statements in Appendix 1.

ANALYSIS OF PLANS CONSIDERED IN PRELIMINARY PLANNING

During the early stages of this study, various configurations of ice breaker structures and locations were analyzed. Therefore, preliminary planning generally involved an attempt to identify the most practical ice-breaker designs and anchorage locations and layouts to be considered in detail.

The various anchorage configurations investigated and shown on Figure 6 include the following:

Alternative A - A series of 15 ice breaker structures to protect the north anchorage. The icebreaker structures would be located at the western end of the anchorage with seven extending to the northwest and eight extending east along the anchorage boundary.

Alternative B - Construction of a rubble mound jetty beginning about 1,600 feet west of the town landing and extending about 700 feet in a south-southeasterly direction to the southwest corner of the north anchorage, then extending about 250 feet eastward along the south side of the north anchorage.

Alternative C - Construction of a new anchorage to the east of the existing town pier. The anchorage would be 3 acres in size and protected by a series of 11 icebreaker structures. This would entail dredging approximately 9,400 cubic yards of clean sand. Additionally, two icebreaker structures would be placed to the west of the city pier to protect it from ice damage.

Alternative D - Construction of a new anchorage to the east and in the shadow of the town pier. The anchorage would be 3 acres in size and would be protected from ice floes by being in the shadow of the town pier to the maximum possible extent. This would entail dredging approximately 12,500 cubic yards of clean sand and placing nine icebreaker structures. This plan also calls for two icebreaker structures to be placed upstream of the city pier to protect it from damage caused by ice floes.

In summary, all proposed alternatives would allow for approximately 3 acres of anchorage that offer varying degrees of protection from ice floes. These configurations would allow for the anchorage of 15-16 boats of the type used by commercial fishermen in the Saco region.

COMPARATIVE ASSESSMENT AND EVALUATION OF PRELIMINARY PLANS

An evaluation of the alternatives considered indicated that not all conform to the planning constraints and study objectives as expressed in the problem and opportunity statements.

Alternative A, consists of constructing a series of 15 icebreaker structures around the western portion of the north anchorage. This alternative would have minimal environmental impact on the river. The riverbed would be disturbed during construction but upon completion of icebreaker installation, the system would have a negligible effect on the river's biota and currents and piles would provide a habitat for barnacles and mussels. The pile structures would not increase currents in the river to a measureable degree, therefore, there would be no detrimental effects upon adjacent landforms. This plan would permit some increased winter utilization of Camp Ellis Harbor and reduce ice damages sustained by the winter fleet. The plan would provide adequate protection from sheet ice floes to anchored craft. However, sheet floes will still be able to flow through the eastern half of the anchorage and may cause difficulty for craft entering or exiting the anchorage. Problems with chunk ice would remain unchanged as chunk ice would still form in the anchorage and shoreward of the anchorage. Due to a lesser salt content than waters seaward of the city pier because of current action and the constriction in the river caused by the city pier, sheet ice usually forms along the shoreline and out into Camp Ellis Harbor in the area immediately upstream of the city pier. Historical observations indicate that this condition would be present for approximately 2-1/2 months of the 4 month winter fishing season. Although the placement of icebreakers would break and deflect ice moving down the open main channel, sheet ice would continue to extend outward from the shore and into the anchorage area during the winter months resticting the use of this area as a winter anchorage. This is seen in the limited ice movement data presented in Appendix 4 and is confirmed by local officials and fishermen. Therefore, although the upstream anchorage would be the least costly to construct it would only be useful for 30-45 days during the winter fishing season since it would be subject to icing conditions for most of the winter fishing season.

Alternative B, the rubble mound jetty would prevent any sheet ice from entering the protected portion of the north anchorage but would have the greatest impact on the river. The available cross sectional area of the river would be reduced at the jetty site, altering the river currents at this point and affecting the vertical mixing of the water column. Altering the river currents may have a large negative impact on the river biota. In addition, the variations in the vertical profiles of temperature and salinity induced by the tides in Camp Ellis Harbor may also be affected. Construction of the jetty may also promote unnatural erosion of the shoreline. Other problems may also be encountered with this alternative, such as silting on the downstream side of the jetty, restricted navigation year round, and freezing of the anchorage area during the winter.

Alternative C would provide a new anchorage with icebreaker protection to the east of the existing city pier. This alternative would involve dredging approximately 9,400 cubic yards of material. The environmental impacts associated with constructing icebreakers would be similar to Alternative A. The impacts associated with dredging and

material disposal are more complex; however, they are short term impacts associated with disturbing river biota which would not have any long term negative effect. Alternative C would provide an increased level of protection against chunk ice, as historically, little to no chunk ice forms in this area. The shadow effect of the city pier in conjunction with icebreaker structures will provide a level of protection against sheet ice greater than Alternative A. This plan achieves both study objectives and addresses the problem of chunk ice, a difficulty not alleviated by either Alternatives A or B.

Alternative D would provide a new anchorage to the east of the existing city pier taking maximum advantage of the shadow effect of the pier structure, thus minimizing the number of icebreaker structures required. This plan would involve dredging approximately 12,500 cubic yards of material. The environmental impacts of dredging and icebreaker placement would be similar to Alternative C. Protection against chunk ice flows would be similar to Alternative C. Additionally, this plan would provide the maximum amount of protection against sheet ice flows. This plan achieves study objectives as stated in the problem and opportunity statements and offers the highest level of protection against sheet ice floes.

CONCLUSIONS

Based on an evaluation of the degree to which each alternative attained the planning objectives and worked within the planning constraints, Alternatives A, C and D have been selected for further evaluation. Alternative B was eliminated from further consideration due to the high construction cost, negative environmental impacts, and possible freezing over of the anchorage during the winter. The following sections of this report will assess and evaluate in detail the selected alternatives, hereafter referred to as Plans A, C and D.

ASSESSMENT AND EVALUATION OF DETAILED PLAN

The preliminary screening of alternatives has resulted in the conclusion that an anchorage area protected by icebreaker structures is the most effective means of adequately providing protection to the winter fishing fleet from ice floes moving down the Saco River and allowing year-round use of the harbor by commercial fishermen. The economic analyses which were used to determine the optimal anchorage size are located in Appendix 5.

The detailed plans described in the following sections are basically variations of anchorage alternatives. The variations involve differences in anchorage location and configuration and number and location of icebreaker structures. An analysis of the icebreaker design with regard to most effective configuration and construction materials is located in Appendix 4. Impacts which are common to plans will be discussed in the following sections. Impacts which are unique to each plan are evaluated in subsequent sections of this report.

GENERAL ASSESSMENT AND EVALUATION OF IMPACTS

All three detailed plans will provide protection to commercial fishing craft from ice floes during the winter months. On 22 September 1980, members of the Corps of Engineers' Cold Regions Research and Engineering Laboratory (CRREL) visited Camp Ellis Harbor to determine the extent of the existing ice problem and evaluate the effect structures would have on the ice in the river. It was the opinion of the CRREL representatives that locating the fishing fleet in the downstream shadow of the city pier would be the safest solution for winter anchorage. This would involve some dredging and placement of pile clusters in line with the channel and downstream of the city pier at a spacing of no more than 50 feet to keep large ice floes out of the proposed anchorage area.

All three detailed plans would have impacts with short and long term implications. Physical activities associated with the construction would have short term impacts on the aquatic ecosystem. The activities associated with dredging and placing ice breaker structures in the river will cause a temporary loss of water quality due to the suspension of material in the water column. There will also be temporary disruptions of benthic organisms, as well as some localized effects on finfish. These temporary adverse effects may occur during construction; however, conditions would stabilize once the project is completed. Although any benthic organisms present in the affected area during dredging as proposed in Plans C and D operations would be destroyed, studies have shown that recolonization would occur within a year. Additionally, the pile structures as proposed in all three detailed plans would provide a new habitat for marine organisms.

The impacts associated with the dredging of a six-foot deep, three acre anchorage should be minimal since the material to be dredged is clean sand and will be used to nourish Camp Ellis Beach, to the north of the mouth of the Saco River, as shown on Figure 7. Disposal of the dredged material on Camp Ellis Beach would help to stabilize the beach face and provide natural storm protection to houses along the beach.

Construction of an anchorage to the east of the city pier should cause little change in the dynamics of the estuary since the construction of the river channel represented by the existing pier structure (primarily a paved over sandbar) is the controlling factor in this reach of the river. Increasing the cross sectional area of the channel will tend to induce shoaling particularly since the proposed anchorage locations are substantially sheltered from ebb tidal flows by the existing pier. The factor that would control the shoaling rate would be the sediment supply to the area which is limited by the mile long entrance jetties.

The recreational users of Camp Ellis Harbor would gain some additional space in the existing north and south anchorages under Plans C and D as commercial craft are expected to anchor in a new anchorage area on a year round basis thus providing additional space for recreational users in the existing anchorages.

All plans considered in detail will result in both social and economic impacts to the city of Saco. These impacts are more fully discused in Appendix 5.

Social impacts resulting from the harbor improvement would include reduced unemployment as a positive impact. Some adverse impacts might result from increased truck traffic to the harbor during the winter months although this should be minimal.

There should be little, if any, impact to the summer residents of Camp Ellis and the recreational users of Camp Ellis Harbor because the major portion of the increased commercial activity will occur during the fall and winter months when summer users are not in residence.

The economic impacts associated with improvement of the harbor include: increased income to local fishermen as well as the industries associated with servicing the fishermen; increased tax revenue to Federal, State and local governments; and reduced contributions from these governments in unemployment and welfare payments through increased employment opportunities.

MITIGATION REQUIREMENTS

In order to reduce potential impacts of the proposed improvement construction timing is of the utmost importance. Dredging and/or ice breaker placement should be scheduled for completion during the fall or winter in order to avoid any adverse environmental damage that could

result if construction operations were conducted during the more productive spring and summer seasons. Dredging in the fall and winter will avoid the spring-summer spawning of alewives and the summer spawning time of soft-shell clams. Also, most waterfowl and shorebirds will nest in the spring and summer. Furthermore, at the suggestion of the U.S. Fish and Wildlife Service, enhancement of the project site will be undertaken with the construction of an osprey nesting platform.

IMPLEMENTATION RESPONSIBILITIES

The implementation responsibilities for all three detailed plans are not significantly different. Consequently, in the following paragraphs a discussion of cost allocation and apportionment as well as Federal and non-Federal responsibilities will be given.

COST ALLOCATION AND APPORTIONMENT

All of the quantifiable benefits that would result from any of the detailed plans of improvement for Camp Ellis Harbor would accrue and can be allocated to the existing and project commercial users of Camp Ellis Harbor. Consequently, all costs for construction would become a Federal responsbility.

Both of the detailed plans considered involve anchorage dredging and icebreaker construction, and funds for construction will be allocated through the Chief of Engineers, acting under the authority of Section 107 of the 1960 River and Harbor Act.

All costs associated with the initial project construction except for any costs of spreading and grading dredged materials on Camp Ellis Beach will be a Federal responsibility.

FEDERAL RESPONSIBILITIES

The Federal Government will assume all costs, within the Federal cost limitation of $2,000,000, for initial construction of this project because of the general, or widespread nature of benefits to commercial navigation except for all costs associated with containment of any dredged material. In addition the Federal Government will maintain this waterway improvement to assure continued navigability. All pre-authorization study costs as well as the design, preparation of plans and specifications, and contract administration are Federal responsibilities.

NON-FEDERAL RESPONSIBILITIES

The city of Saco, Maine, the local sponsor, would be responsible for the operation and maintenance of an adequate public landing for the sale of fuel, lubricants, and drinking water to all on an equal basis, and for providing all necessary lands, easements, and rights-of-way for construction and subsequent maintenance of the project, including disposal areas for dredged materials.

The city would also hold the United States free from damages that may result from construction and maintenance of the project. Moreover, the local sponsor would provide and maintain berths and other mooring facilities for local and transient vessels as well as access roads, parking lots and other required public use shore facilities, open and available to all on an equal basis.

The local sponsor would assume the responsibility for all project costs in excess of $2,000,000. Finally, the city would establish regulations prohibiting the discharge of untreated sewage and other pollutants into the waters of the Saco River.

PLAN EVALUATION

PLAN A

PLAN DESCRIPTION

Plan A consists of constructing a series of ice breaker structures to protect the existing 6 foot deep mlw north anchorage. The ice breaker structures would be located at the western end of the anchorage. A total of 15 ice breakers would be needed to provide adequate protection to vessels moored in the anchorage. Seven of the ice breakers would extend in a line to the northwest of the anchorage from the channel limit towards the shore, while the remaining eight structures would extend to the east along the existing anchorage-channel boundary.

IMPACT ASSESSMENT

Icebreaker Impacts - Plan A would have minimal environmental impact on the river. It would entail no dredging since the area to be protected by icebreakers is the upstream half of the 6-acre Federal anchorage. The riverbed would be disturbed during construction but upon completion of the icebreaker installation, the system would have a negligible effect on the river's biota and currents and the piles would provide new habitat for barnacles and mussels. The pile structures would not increase river currents to a measureable degree, therefore, there would be no detrimental effects upon adjacent landforms.

Impacts on Navigation - Plan A would provide 1 to 1-1/2 months of fishing during the 4 month winter season. During the remainder of the winter season the anchorage would be subject to sheet icing from ice formations extending outward from the shore and into the anchorage area restricting its use. The icebreaker structures would be permanent obstacles in the river that would have to be avoided. However, the distance between them (50 ft.) will be sufficient so that all boats in the anchorage should have no difficulty maneuvering around them. In the proposed positions, these icebreakers would not interfere with navigation in the Federal channel.

Economic Impacts - Icebreaker costs are based on the use of the most economical materials in the construction of the icebreaker structures and the arrangement of the icebreaker structures that minimizes their number while providing the desired level of ice protection.

The estimated first cost of Plan A is $131,400. The annual cost is $12,200 based on an interest rate of 7-3/8 percent amortized over a 50-year period. The annual project benefit is estimated at $45,400.

Annual costs and benefits are as follows.

Annual Costs	Annual Benefits	B/C Ratio	Net Benefits
$12,200	$45,400	3.7	$33,200

EVALUATION AND TRADEOFF ANALYSIS

Plan A would entail no dredging since the area to be protected by icebreakers is the usptream half of a 6-acre Federal anchorage maintained to 6-feet mlw. The 15 icebreakers would have a negligible effect of the river's biota or current patterns. There would be no detrimental effect on the adjacent shoreline and the piles would provide a habitat for a wide range of plants and animals that affix themselves to intertidal and subtidal objects. The wooden nesting platform provided would serve as a nesting area for ospreys or other birds.

Plan A would have minimal environmental impact on the river. The riverbed would be disturbed during construction but upon completion of icebreaker installation, the system would have a negligible effect on the river's biota and currents and piles would provide a habitat for barnacles and mussels. The pile structures would not increase currents in the river to a measureable degree, therefore, there would be no detrimental effects upon adjacent landforms. Plan A would permit some increased winter utilization of Camp Ellis Harbor and reduce ice damages sustained by the winter fleet. The plan would provide adequate protection from sheet ice floes to anchorage craft. However, sheet floes will still be able to flow through the eastern half of the anchorage and may cause difficulty for craft entering or exiting the anchorage. Due to a lesser salt content than waters seaward of the city pier because of current action and the constriction in the river caused by the city pier, sheet ice usually forms along the shoreline and out into Camp Ellis Harbor in the area immediately upstream of the city pier. Historical observations indicate that this condition would be present for approximately 2-1/2 months of the 4 month winter fishing season. Although the placement of icebreakers would break and deflect ice moving down the open main channel, sheet ice would continue to extend outward from the shore and into the anchorage area during the winter months restricting the use of this area as a winter anchorage. This is seen in the ice movement data presented in Appendix 4. Therefore, the upstream anchorage would only be useful for 30-45 days during the winter fishing season since it would be subject to icing conditions for most of the winter fishing season.

COST APPORTIONMENT

Local interests would be required to bear all costs in excess of the $2,000,000 Federal cost limitation. In addition, a 100 percent share of related improvements would be a local responsibility.

PUBLIC VIEWS

Federal Agencies - Pending review of the Detailed Project Report.

Non-Federal Agencies and Others - Pending review of the Detailed Project Report.

PLAN C

PLAN DESCRIPTION

Plan C would provide a new 3 acre anchorage protected by 11 icebreaker structures located to the east of the existing city pier and adjacent to the Federal channel as shown on Figure 6. This plan would also include placing two icebreaker structures immediately upstream of the city pier to protect it from damage caused by ice floes. The anchorage would be dredged to a depth of 6 feet MLW and would require the removal of 9,400 cubic yards of clean sand. The icebreaker structures would be constructed of steel pipe. Details of the ice breaker design may be found in Appendix 4.

IMPACT ASSESSMENT

Construction Impacts - The icebreakers would have only negligible impacts on the river environment with the exception of providing a habitat for mussels, barnacles and other organisms which would affix themselves to the piles. The osprey nesting platform to be affixed to the second eastern most of the icebreakers placed along the channel limit would provide a nesting area for ospreys or other birds.

Plan C involves the dredging of approximately 9,400 cubic yards of sand and gravel, permanently altering 3 acres of river bottom, 0.3 acres of which would be removed from the intertidal zone. A further 0.5 acres of intertidal zone would be altered in depth. Destruction of the bottom habitats is only temporary however since recolonization of the deepened anchorage bottom would take place over time.

Disposal of the dredged sand would take place on Camp Ellis Beach where the material would be used for beach nourishment purposes. Dredging and disposal would cause temporary increased levels in turbidity and resulting temporary degradation of water quality. Since the material is composed of predominantly clean sand and gravel only very limited release

of sediment trapped pollutants is expected to occur. Reworking and washing of the disposed sand by waves, currents and storms will take place before the summer season since construction would take place during the wintr months.

IMPACT ON NAVIGATION

Plan C would allow for the utilization of Camp Ellis Harbor on a year round basis. The icebreaker structures would be permanent obstacles in the river that would have to be avoided. However, the distance between them (50 ft.) will be sufficient so that all boats in the anchorage should have no difficulty maneuvering around them. In the proposed positions, these icebreakers would not interfere with navigation in the Federal channel. The two structures protecting the city pier are positioned to minimize interference with boats maneuvering in the pier area.

ECONOMIC IMPACTS

Dredging costs are based on using hydraulic methods with the dredged material being used to nourish Camp Ellis Beach. Icebreaker costs are based on the use of the most economical materials in the construction of the icebreaker structures and the arrangement of the icebreaker structures that minimizes their number while providing the desired level of ice protection.

The estimated first cost of Plan C is $237,700. The annual cost, based on an interest rate of 7-3/8 percent is $29,000. The annual project benefit is estimated at $121,700.

Annual costs and benefits are as follows.

Annual Costs	Annual Benefits	B/C Ratio	Net Benefits
$29,000	$121,700	4.2	$92,700

EVALUATION AND TRADEOFF ANALYSIS

Plan C provides a high level of protection from ice floes. Therefore, this plan will allow for winter utilization of the harbor by the commercial fishing fleet and as an added benefit, will increase the available anchorage area during the recreational boating season.

COST APPORTIONMENT

Local interests would be required to bear all costs in excess of the $2,000,000 Federal cost limitation. In addition, a 100 percent share of related improvements and all spreading and grading of dredged material on the beach would be a local responsibility.

PUBLIC VIEWS

Federal Agencies - Pending review of the Detailed Project Report.

Non-Federal Agencies and Others - Pending review of the Detailed Project Report.

PLAN D

PLAN DESCRIPTION

Plan D would provide a new 3 acre anchorage protected by 9 icebreaker structures located to the east of the existing city pier and taking maximum advantage of the "shadow effect" or protection from ice floes afforded by the pier. This plan also includes placing 2 icebreakers upstream of the city to protect it from damage caused by ice floes. The anchorage would be located adjacent to the Federal channel as shown on Figure 6. The anchorage would be dredged to a depth of 6 feet MLW and would require the removal of 12,500 cubic yards of clean sand. The icebreaker structures would be constructed of marine steel. Details of the icebreaker design may be found in Appendix 4.

IMPACT ASSESSMENT

Construction Impacts - The ice breaker piles will not have any major adverse effect upon the river biota and will provide a habitat for marine plants and animals such as mussels and barnacles. The osprey nesting platform positioned above one of the piles would hopefully provide a nesting area for ospreys and other birds.

Since Plan D involves anchorage dredging closer to shore the volume of dredged material will be greater than that in Plan C. A greater area of the intertidal zone, approximately 1.0 acres will be removed. A further 0.5 acres of the intertidal zone will be altered. A temporary destruction of 3 acres of bottom habitat will be experienced, however recolonization of the new anchorage bottom will take place over time.

The material dredged to construct the anchorage in Plan D is expected to be predominantly clean sand and gravel and will be used for beach nourishment purposes to widen Camp Ellis Beach. Dredging and disposal of dredged material are not expected to cause the release of sediment trapped pollutants due to the relatively clean and coarse nature of the sediments in question. Reworking of the nourishment sand by waves, currents and storms will take place before the summer season since winter construction is planned.

IMPACT ON NAVIGATION

Plan D would allow for the utilization of Camp Ellis Harbor on a year round basis. The icebreaker structures would be permanent obstacles in the river that would have to be avoided. However, the distance between them (50 ft.) will be sufficient so that all boats in the anchorage should have no difficulty maneuvering around them. In the proposed positions, these icebreakers would not interfere with navigation in the Federal channel.

ECONOMIC IMPACTS

Dredging costs are based on using hydraulic methods with the dredged material being used to nourish Camp Ellis Beach. Icebreaker costs are based on the use of the most economical materials in the construction of the icebreaker structures and the arrangement of the icebreaker structures that minimizes their number while providing the desired level of ice protection.

The estimated first cost of Plan D is $260,900. The annual cost, is $33,300 based on an interest rate of 7-3/8 percent amortized over a 50-year period. The annual project benefit is estimated at $121,700.

Annual costs and benefits are as follows.

Annual Costs	Annual Benefits	B/C Ratio	Net Benefits
$33,300	$121,700	3.6	$88,400

EVALUATION AND TRADEOFF ANALYSIS

Plan D, taking more advantage of the piers protective "shadow effect" in blocking ice floes, provides a slightly greater level of protection from ice floes than Plan C. This plan will allow for winter utilization of the harbor by the commercial fishing fleet and as an added benefit, will increase the available anchorage during the recreational boating season.

COST APPORTIONMENT

Local interests would be required to bear all costs in excess of the $2,000,000 Federal cost limitation. In addition, a 100 percent share of related improvements and all spreading and grading of dredged material on the beach would be a local responsibility.

PUBLIC VIEWS

Federal Agencies - Pending review of the Detailed Project Report.

Non-Federal Agencies and Others - Pending review of the Detailed Project Report.

COMPARISON OF DETAILED PLANS

Generally the three plans can be categorized as being of two types. Plan A involves improvement measures aimed at protecting the western half of the existing northern Federal anchorage. This plan therefore requires no dredging nor do they entail the adverse environmental impacts associated with dredging or the environmental benefits to be gained by providing sand for beach nourishment at Camp Ellis Beach. This plan also fails to protect against chunk and shore ice buildup and related damages and therefore provide less economic benefits than the other two plans.

The dredging plans (C and D) yields greater benefits by providing greater utility and protection from ice damage. The dredging plans also entail benefits derived from the beach nourishment plan. Both dredging plans have the adverse environmental impacts associated with dredging such as temporary destruction of benthic habitats, temporary degradation of water quality and the release of sediment trapped pollutants to the water column.

There is generally trade-off between the degree of protection provided by a plan and the amount of dredging. The two dredging plans provide the greatest degree of protection from all types of ice while Plan A fails to provide relief from damages attributable to chunk ice and shoreline ice buildup.

Plan A provides the least degree of protection and entails the minimum amount of construction and costs. Plan A also entails the least amount of impacts on the environment and the least social impacts. Plan A provides the least net benefits.

Plan C provides the greatest net benefits of any of the proposed plans, the sheltering effect of the city pier on the downstream anchorage provide a greater degree of protection than ice breakers and thereby minimizes the number of ice breakers needed. The greater cross-sectional area of the estuary below the landing results in a lesser degree of chunk and shore ice formation than that in the existing anchorages above the city landing. Plan C provides for protection of the wooden pilings of the city dock and proposed extension by the provision of two ice breakers upstream of the pier. These two icebreakers also serve to protect vessels offloading and maneuvering at the end of the pier.

Plan C entails the usual temporary adverse impacts associated with dredging as discussed earlier in this section and the benefits derived from beach nourishment and the provision of an osprey nesting platform.

Plan D provides a level of protection similar to Plan C. Plan D also entails the greatest amount of dredging and therefore fails to optimize net benefits as does Plan C. Plan D involves the least number of ice breaker structures and the greatest extent of beach nourishment.

In order to provide its level of protection, Plan D involves the dredging of an anchorage which extends closer to the shoreline and the city landing. This would result in removal of a grater portion of the intertidal zone (1.0 acres) and therefore greater long-term environmental impacts than any other alternative plan. This adverse impact is only partially mitigated by the provision of a nesting platform.

Plan D provides for two ice breaker piling emplaced upstream of the city pier as does Plan C. These ice breakers serve to protect the wooden dock pilings and vessels offloading and maneuvering at the end of the pier.

COST COMPARISON

Table 1 compares the cost of Plans A, C and D in detail. A more detailed cost breakdown is found in Appendix 4. Table 1 also lists the annual charges associated with each detailed plan. In developing these annual charges, a Federal cost of 7-3/8 percent over a 50 year project life was used.

TABLE 1
COST OF DETAILED PLANS

	PLAN A	PLAN C	PLAN D
Construction Costs			
Dredging		$86,900	$115,600
Icebreakers $6000/ea	$90,000	78,000	66,000
Osprey Nest	3,000	3,000	3,000
Contingencies	18,600	33,600	36,900
Engineering and Design	8,900	16,100	17,700
Supervision and Administration	8,900	16,100	17,700
Subtotal	$129,400	$233,700	$256,900
Aids to Navigation	2,000	4,000	4,000
Total Construction Costs	$131,400	$237,700	$260,900

ANNUAL CHARGES

	PLAN A	PLAN C	PLAN D
Interest and Amortization	$10,000	18,000	19,800
Annual Maintenance	—	8,600	11,300
Icebreaker Replacement Costs	1,700	1,400	1,200
Aids to Navigation	500	1,000	1,000
Total Annual Cost	$12,200	$29,000	$33,300

BENEFIT COMPARISON

As mentioned previously, each of the detailed plans would offer sufficient protection to the users of Camp Ellis Harbor to result in significantly increased landings at the harbor due to an extended fishing season.

Furthermore, transportation savings could be expected to accrue under each improvement plan to fishermen who presently relocate to other ports for winter operations.

Reduction of damages to both permanently moored vessels could be anticipated in equal amounts through the implementation of either one of the alternatives.

A detailed discussion of benefits is given in Appendix 5. However, a breakdown of annual benefits for the detailed plans are shown in Table 2.

TABLE 2
ANNUAL BENEFITS

	PLAN A	PLAN C	PLAN D
Increased Net Income to Fishermen	42,300	112,800	112,800
Transportation Savings	600	1,600	1,600
Reduction in Damages		1,500	1,500
Elimination of Extra Fees	2,500	3,500	3,500
Elimination of Boat Hauling		2,300	2,300
TOTAL	45,400	121,700	121,700

Table 3 lists the benefit-cost ratios for the detailed plans along with the net economic benefits for each plan, given on an annual basis.

TABLE 3
ECONOMIC IMPACTS

	PLAN A	PLAN C	PLAN D
B/C Ratio	3.7	4.2	3.6
Net Benefits	$33,200	$92,700	$88,400

COMPARISON SUMMARY

Table 4, entitled "System of Accounts," is a general analysis relevant to plan selection. It presents the determinative factors that underlie each final alternative by displaying the significant beneficial and adverse impacts. This system is utilized for the purpose of tradeoff analysis and final decision making.

TABLE 4
SUMMARY TABLE

	WITHOUT PROJECT	PLAN A	PLAN C	PLAN D
A. PLAN DESCRIPTION	No Action	15 icebreakers around north	3 acre anchorage 13 icebreakers	3 acre anchorage 11 icebreakers
B. IMPACT ASSESSMENT				
1. National Economic Development				
a. Annual Benefits	0	$45,400	$121,700	$121,700
b. Annual Cost	0	$12,200	29,000	33,300
c. B/C Ratio	0	3.7	4.2	3.6
d. Net Benefits	0	$33,000	92,700	88,400
2. Environmental Quality				
a. Icebreaker impacts on tidal currents	-	minimal	minimal	minimal
b. Icebreaker impacts on water quality	-	none	none	none
c. Dredging impacts on water quality	-	-	significant but temporary	same as C
d. Shoreline impacts	none	none	yes	yes
e. Enhancement of beach area	none	none	yes	yes
C. PLAN EVALUATION				
1. Conforms to Planning Constraints and Concerns				
a. Avoids dredging during summer	-	-	yes	yes
b. Avoids increasing natural rates of riverbank erosion	-	yes	yes	no
2. Achieves planning objectives and goals				
a. Provides for safe year round navigation facilities	no	no	yes	yes
D. PUBLIC RESPONSE				
a. Plan Found Acceptable	no	no	yes	yes
E. IMPLEMENTATION RESPONSIBILITY				
a. Federal Share (%)	0	100	100	100
b. Local Share (%)	0	0	0	0

RATIONALE FOR DESIGNATION OF NED PLAN

Plan C is the alternative which maximizes net economic benefits. Net economic benefits are maximized when plan scale is optimized and the plan is efficient. Scale is optimized when the benefits of the last increment of output for each measure in the plan equals the economic costs of that increment. A plan is efficient when the outputs of the plan are achieved in a least cost manner.

Each of the alternative plans were evaluated according to their level of contribution to national economic development. The level of contribution is determined through summation of the benefits and adverse economic effects attributed to each plan. Benefits relative to improvement plans for Camp Ellis Harbor include changes in gross revenues/increased landings, and changes in associated costs/reduced damages. Descriptions of the benefit and cost analysis of the economic and biological study areas, relative to each of the detailed plans is containted in Appendix 5. For Camp Ellis Harbor, the plan that optimizes scale and is efficient is the plan that affords an adequate degree of protection at the least cost. This would be the NED Plan, and for Camp Ellis Harbor is Plan C.

RATIONALE FOR DESIGNATION OF EQ PLAN

In designation of the environmental quality or EQ plan, it is recognized that environmental quality has both natural and human manifestations. Beneficial EQ contributions are made by preserving, maintaining, restoring, or enhancing the significant cultural and natural environmental attributes of the study area.

The waters of the Saco River estuary are presently classified by the State of Maine as SC from the head of tide to the Camp Ellis breakwater. As stated in the Maine Water Pollution Control Law, Class SC waters "shall be of such quality as to be satisfactory for recreational boating, fishing and other similar uses except primary water contact. Such waters may be used for the propagation of indigenous shellfish to be harvested for depuration purposes for a fish and wildife habitat, and for industrial cooling and process uses.

In summary, the Saco River has moderate water quality problems specifically related to the high coliform bacteria counts. Coliform counts exceed Class SC requirements necessitating the closing of the entire estuary to shellfishing. In addition, periodic shock loading due to storm water overflow from the combined sewer systems in Saco and Biddeford also result in localized water quality problems in the Saco Estuary. Consequently, in looking at detailed alternatives for harbor development, the EQ Plan would be the one that has the least negative impact on the existing harbor conditions and as a result, the least potential impact on the harbor environment.

In evaluating at the alternative plans considered in this study, the plan which would have the least impact on the existing harbor conditions is Plan A. Although placing the icebreakers would destroy that habitat directly underneath the piles, the piles would offer new subtidal and intertidal habitat for plant and animal life. Plan A would eliminate approximatley 47 square feet of existing habitat but would create approximately 942 square feet of subtidal habitat and 942 square feet of intertidal habitat. Therefore, Plan A which involves the minimum amount of environmental disruption, while adding new and larger areas for plant and animal communities is designated as the EQ Plan.

RATIONALE FOR SELECTED PLAN

Plan C is the selected plan. Of the three alternative plans considered in detail, Plan C provides the maximum net benefits while it also has a minimal impact upon the environment at the project location.

RECOMMENDED PLAN

Based on the applicable engineering, economic, and environmental criteria, Plan C, consisting of dredging an anchorage and providing icebreaker structures, was found to be the most favorable plan of improvement to meet the needs of the commercial fishing fleet based at Camp Ellis Harbor. The recommended plan is shown in Figure 8.

The recommended plan would provide 3 acre anchorage area dredged to a depth of 6 feet MLW located to the east of the existing city pier and protected by a series of 11 icebreaker structures. It will also provide 2 icebreaker structures to protect the city pier. The plan will require dredging approximately 9,400 cubic yards of sand that will be used for beach nourishment at Camp Ellis Beach.

The total construction investment for the recommended plan is estimated to be $237,700. Annual benefits that would result from the recommended plan, principally increased net income to fishermen, amount to $121,700 which when compared to annual charges of $29,000 yield a benefit-cost ratio of 4.2.

ENVIRONMENTAL ASSESSMENT

CAMP ELLIS HARBOR

SACO RIVER

SACO, MAINE

ENVIRONMENTAL ASSESSMENT

INTRODUCTION

In keeping with the National Environmental Policy Act of 1969, the New England Division of the U.S. Army Corps of Engineers, has examined environmental values as part of the planning and development of the proposed action plan. Background environmental information was compiled for purposes of this report through environmental sampling, interviews with various State and local interest groups, and a search of published literature. This report provides an assessment of environmental impacts and alternatives considered and contains other applicable data to the Section 404 Evaluation requirements.

EXISTING CONDITIONS

The existing Federal Navigation Project, as shown in Figure 2 of this report, provides for a channel 8 feet deep, 9 feet in ledge, from the sea to the head of navigation at Saco and Biddeford for a distance of about 6 miles, with channel widths as follows: 140 feet across the bar, 200 feet in lower section between the jetties, 140 feet in middle section, and 100 feet in upper section. The project also provided for a small quantity of rock excavation; several small riprap jetties within the river, a riprap breakwater about 6,600 feet long extending seaward from the north side of the river mouth; and a riprap jetty about 4,800 feet long extending from the south side of the river mouth, about parallel with the breakwater. Additional work authorized in 1967 provides for two anchorages at the river mouth totaling 10-1/2 acres in area and a 10-acre maneuvering basin at the head of navigation, all to a depth of 6 feet.

The project was last dredged during fiscal year 1979 when material was excavated from the entrance channel. This material was predominantly clean sand that was disposed of as beach nourishment sand on the southern portion of Camp Ellis Beach.

PURPOSE AND NEED FOR ACTION

Commercial fishing craft anchoring in Camp Ellis Harbor during the winter months are constantly exposed to damage from ice floes moving down the Saco River. The gross haul of fish at Camp Ellis Harbor does not approach its potential total, however, because the lack of an ice free anchorage compels most fishermen to haul their boats ashore or relocate to other harbors including Cape Porpoise, Kennebunkport and Biddeford Pool. Fishing from Camp Ellis Harbor is thus a risky proposition for fishermen and is reflected in the near termination of commercial activity at Camp Ellis during the winter months due to the extensive damage that has been inflicted on moored craft by large sheets of ice that form in the predominantly fresh winter upstream, break away, and follow the current downstream into the existing anchorage area.

ALTERNATIVES INCLUDING THE PROPOSED ACTION

In considering the protection and navigational needs of the existing and future commercial fleet at Camp Ellis Harbor four alternative plans of improvement as shown in Figure 6 were evaluated. The proposed action is alternative C, construction of a new anchorage to the east of the existing town pier.

NO FEDERAL ACTION

If no Federal action is taken the Corps of Engineers will continue periodic maintenance dredging in the existing anchorage on an as needed basis and contingent upon the availability of funds. Problems with the formation and movement of ice in the anchorage and pier area will continue along with attendant damages and navigation safety problems as described in the previous section. Without construction of the project there will be no adverse environmental impacts, but there will be economic impacts effecting man's environment and the social well-being and safety of the Camp Ellis community, which are detailed in Appendix 5 of this report.

If Camp Ellis Harbor is to take full advantage of the new opportunities created by the 200 mile fishing limit and increasing market demands, the commercial fisheries at Camp Ellis must become a year round operation. This can only be achieved if a safe winter anchorage is available to the fleet. Accordingly, the "no improvement" option is neither consistent with new opportunities for growth and economic vitality at Camp Ellis Harbor, nor does it conform with local and State plans for the expansion of commercial fisheries in Maine.

PROPOSED ACTION

The proposed plan of improvement as shown in Figure 8, is Plan C, which consists of the following:

- Dredging of a 3 acre area below the city pier, on the north side of the existing 8 foot channel, to a depth of 6 feet mlw.
- Emplacement of 11 steel icebreaker pilings to protect the new anchorage, two between the anchorage and the pier and nine along the channel-anchorage boundary.
- Emplacement of two steel icebreaker pilings west of the city pier to protect off-loading vessels and the pier.
- Construction of an osprey nesting platform to be placed atop a pole attached to the second easternmost icebreaker piling at a level of 35 feet above mlw.

ALTERNATIVE METHODS OF DREDGING

The method of dredging generally depends on the method of disposal selected. If disposal at a nearby land site is chosen, as proposed, then a hydraulic dredged would be used. If ocean disposal, or disposal at a distant land site is chosen, then a mechanical dredge is utilized. Thus, there are few choices in dredging methods once a disposal alternative has been selected.

ALTERNATIVE DISPOSAL METHODS AND POSSIBLE SITES

In order to determine the most environmentally and economically acceptable method of disposal two alternative disposal sites were identified. Two nearby historic dump sites, one an ocean disposal site and the other a beach nourishment site were examined.

OCEAN DISPOSAL SITE

The nearest historic ocean disposal site to Camp Ellis is the Cape Arundel Dumpsite shown in Figure 9. This site was last used for disposal of sediments removed from the Federal navigation project in the Kennebunk River in 1975. The site is located 2.65 miles south of Cape Arundel or approximately 10.2 miles southwest of Camp Ellis Harbor. The site has a depth of approximately 90 to 100 feet and disposal is regulated under Section 103 of the Federal Water Pollution Control Act. The dredged material last deposited there was predominantly fine sand ranged in composition from 0.45 to 1.8 percent fines. The site is located about 15.6 miles by sea from Camp Ellis.

The major concerns in ocean disposal of dredged materials are the potential for impact on identified commercial marine resources and the potential for general low-level deterioration of the overall ocean resource. Only the former can be specifically addressed. Based on the results of sediment analysis, the majority of the material is of coarse grain size which is acceptable for open water disposal under current Section 404 Dredged Material Disposal guidelines.

The unit cost for dredging by a clamshell bucket and transport of spoils by scows towed 15 miles to the Cape Arundel ocean dumpsite for disposal is estimated to be $9.75/cubic yard of sediment or $91,700 for ocean disposal of the 9,400 cubic yards to be dredged under the proposed plan of improvement.

BEACH NOURISHMENT SITE

Historically, sediments dredged from the existing Federal project in the Saco River in the vicinity of Camp Ellis Harbor have been used for beach nourishment purposes at Camp Ellis Beach or Fort Hill Beach. Local residents at Camp Ellis prefer this method of disposal in order to provide protection from waves and storms to shorefront properties. This area was

last used for disposal/nourishment of material removed during maintenance dredging of the existing channel in 1979.

Land disposal at this site would require use of a hydraulic dredged pump to remove material for the proposed anchorage. The sand would be pumped through a pipe across the jetty and distributed along a maximum 500 foot section of Camp Ellis Beach north of the north Saco River jetty.

In addition to enhancing man's environment through expansion of available beach area and protection of property, the adverse environmental impacts of beach nourishment are negligible.

The cost for hydraulic dredging and deposition of the sand as beach nourishment is estimated to be $9.25 per cubic yards or $86,900 for the 9,400 cubic yards to be dredged under the proposed plan.

RECOMMENDED METHOD OF DREDGING AND DISPOSAL

Based on both environmental and economic considerations disposal of the dredged material at Camp Ellis Beach for beach nourishment purposes is judged to be the most acceptable method of disposal. Dredging will be accomplished using a hydraulic dredge and the material will be pumped across the north jetty to the beach disposal site, shown in Figure 7.

Historically, beach nourisment is a valid and constructive use of dredged sediments. Clean dredged sand is pumped to the beach hydraulically and left for reworking by tides, storms, and currents. By conducting the project in late fall or winter, there is maximum likelihood that the beach profile will be restored by the following summer. Disposing of clean sediments on Camp Ellis Beach would be acceptable to State and local interests. The nature of the material to be dredged is compatible with existing sediments at both of these locations.

ECONOMIC CONSEQUENCES AND PROBABLE IMPACTS

The future economic growth of commercial fisheries at Camp Ellis Harbor is largely dependent on whether or not year round fishing operations become viable at Camp Ellis. In the absence of a protection plan, it appears that the size of the commercial fleet will remain stable. If a protection plan is implemented and the fishing season is extended, the additional income to fishermen will increase their ability to upgrade equipment and modernize the local fleet. Over the long run, technological advancements in the fishing industry may cause a local economic decline if the local fleet is unable to effectively operate on a competitive year round basis.

The total catch landed at Camp Ellis Harbor in 1980 was approximately 1,875,000 pounds, estimated to be valued at $1,125,000 including all lobster, shellfish and finfish. The construction of an ice-free anchorage could significantly increase this total by providing an incentive for an additional number of boats, which are normally hauled ashore for the

winter, to operate year-round if they so desire, and by providing additional fishing days that were lost previously due to an inability to navigate the harbor during rough seas and heavy ice conditions. In addition, financial gains would accrue to the fishermen in the form of reduced damages to the fleet and decreased transportation costs for those vessels that are normally transferred to alternative ports for the winter.

RIVER AND HARBOR SEDIMENTS

The Army Corps of Engineers had undertaken several environmental sampling operations in the Saco River over the past several years. With the exception of those samples taken from borings in the proposed improvement areas, the samples were taken from the existing channel in conjunction with maintenance dredging. Three samples taken in 1972 and two in 1976 were sampled from the channel in the vicinity of the Camp Ellis Pier. Two additional samples were taken in 1979 from borings in the area above the pier, considered for improvement in this study.

As shown in Figure 10, a total of four samples were taken from above the pier and three from below the pier. The samples above the pier averaged 1.2 percent fines while the three below the pier averaged 0.8 percent fines. This indicates that the restricted cross sectional area of the channel at the point of the pier and Jordon's Point leads to the deposition of coarser grained material below the pier and finer grained material above the pier.

Two test borings taken on 21 February and 4 March 1980 from the area to be dredged for the recommended plan below the pier indicated moist medium to fine sand (SP) with shell fragments. Two test borings taken on 11-12 September 1979 from above the pier in the existing 6-foot anchorage showed the bottom sediments to be composed of loose sand (SP), silty sand (SM), and silty medium to fine sand (SP-SM) with shell fragments.

Sieve analyses were run for samples taken from the two borings above the city pier. Grain size curves were developed for these and appear in Figures 11 and 12. The material to be dredged under the proposed plan and deposited as beach nourishment sand is of a somewhat coarser nature.

According to the Section 404 guidelines for the discharge of dredged or fill material (Fed. Register, 5 September 1975, para. 230.4(b)(1) p. 41294) further evaluation of chemical-biological interactive effects is not necessary because the sediments meet the following evaluation criteria:

(i) composed predominantly of sand, gravel or any other naturally occurring sedimentary material with particle sizes larger than silt .

(ii)(a) The site from which the material proposed for discharge is to be taken is sufficiently removed from sources of pollution.

(b) Adequate terms and conditions are imposed on the discharge of dredged fill material to provide reasonable assurance that the material will not be moved in currents in a manner damaging to the environment outside of the disposal area.

The sampling results reveal that the sediments to be dredged meet the current EPA criteria for dredging and disposal pursuant to Section 404(b) of the Federal Water Pollution Control Act Amendements of 1972.

PROBABLE IMPACTS OF DREDGING

There are several potential impacts of dredging within the harbor:

Water Column Impacts

Construction of the anchorage will involve dredging sands with a mean grain size of 0.8 mm. Dispersion of sediments will cause a temporary increase in suspended and dissolved solids. This will increase turbidity, diminishing light available for photosynthesis for the short term in localized areas. Turbidity changes associated with dredging have been shown to be temporary and local. Studies of clamshell dredging in the Thames River (Connecticut) have shown that perturbations are limited to within 500 feet of dredging activity (1). The coarse grain-size of sediments at Saco and the fact that a hydraulic dredge will be utilized in which materials are sucked back into the pipeline system will significantly reduce suspension of materials in the area of the dredge.

Dispersion of sediments during dredging may facilitate release of toxic materials into solution. Laboratory studies by Dredged Material Research Program indicate that certain trace metals may be released in the parts per billion (ppb) range while others show no release pattern. Soluble pesticides released into the water column are negligible (2 &3). Since the greatest concentrations of heavy metals and other contaminants are known to be associated with silt-clay sediments little or no impact of such release would be predicted at the dredge site.

Bulk chemical analyses were run on the five samples taken in conjunction with maintenance dredging of the existing Federal channel in 1972 and 1976. The results of these are shown in Table 5. The resulting values obtained for levels of all parameters tested fell below the mean of all similar test results for harbor sediment samples taken from the Gulf of Maine over the past 11 years. The material to be dredged is therefore considered to be chemically acceptable for beach nourishment purposes or other disposal methods.

TABLE 5
Bulk Sediment Test Results
Marine Sediments
Saco River, Saco, Maine

Parameter	GE-1 Brown coarse to medium SAND with shell and wood fragments	GE-2 Black coarse to fine SAND w/shell and organic material	GE-3 Black uniform Medium to Fine SAND w/shell framents and organics	GE-1 Tan medium te find SAND with pieces of wood	GE-6 Tan medium to fine SAND w/shell fragments
Grain Size-Median (mm)	0.9	0.6	0.41	0.68	0.8
% Fines	0.1	1.9	0.9	0.0	0.4
Percent Solids	81.62	76.71	78.99	81.12	93.95
% Volatile Solids - EPA	0.43	1.48	0.95	0.87	0.49
% Volatile Solids - MED	0.35	1.01	0.76	0.67	0.35
Chem Oxygen Dmnd - ppm	600	22,400	13,900	7,310	13,200
Tot. Kjeldahl Nit. - ppm	380	650	510	60	50
Oil & Grease - ppm	270	270	28	220	20
Mercury - ppm	0.04	0.06	0.03	0.024	0.095
Lead - ppm	5.0	15.6	10.1	9.9	8.3
Zinc - ppm	23.8	28.7	27.9	32.0	26.0
Arsenic - ppm	6.7	4.3	7.0	1.6	1.4
Cadmium - ppm	0.5	0.5	0.5	1.5	0.6
Chromium - ppm	3.9	61.0	42.5	15.0	8.5
Copper - ppm	9.2	15.2	7.6	-	-
Nickel - ppm	5.0	5.0	5.0	12.0	5.0
Vanadium - ppm	9.7	10.4	10.1	5.0	5.0

Benthic Impacts

Removal of those organisms within the dredged sediments is an unavoidable result of dredging. Free swimming species such as finfish, and motile species such as crabs and lobster will avoid the actual area of dredging. Recolonization of the dredged area will eventually occur. Recolonization of areas impacted by dredging has been demonstrated within a period of approximately 1-1/2 years in Chesapeake Bay (4). Abundance of dominant species and observed number of species were reduced following dredging, but returned to predredging levels the following year. The icebreaker structures will provide ample surface area for the attachment of a variety of algae and invertebrates. In a letter dated 16 January 1979 the U.S. Fish and Wildife Service stated that "the loss of a small amount of benthic habitat due to icebreaker emplacement is expected to be more than offset by plant and animal communities that will become attached "to intertidal and subtidal portions of the pilings." A copy of this letter is found in Appendix 3.

Historical and Archaeological

Dredging should not have any impact on known historic sites since these are not in the actual project area. During the last maintenance dredging of the Saco River in 1979 the Maine Historic Preservation Commission stated that there were no historic sites in the immediate project area.

ENDANGERED SPECIES IMPACTS

Dredging and icebreaker construction will have no impact on endangered species.

Ospreys, which are a threatened species known to nest in the region, could conceivably be attracted to the Saco River estuary. In a letter dated 16 January 1979 the U.S. Fish and Wildlife Service stated that though "there is no known osprey nesting in the estuary . . . ospreys are occasionally seen at Biddeford Pool" and that "the estuary area appears to be adequately supplied with food resources for ospreys during the nesting season." In order to mitigate against the possibly adverse effects of increased winter commercial fishing operations on the potential for osprey nesting, an osprey nesting platform will be constructed. The platform as shown in Figure 13, will be attached to a pole fixed to the second easternmost icebreaker along the channel/anchorage boundary. The platform will sit at an elevation of 35 feet above mlw.

DISPOSAL IMPACTS

The use of the dredged material as beach nourishment sand to be deposited on Camp Ellis Beach will serve to enhance the environment as well as provide an increased degree of protection for shorefront properties. Widening of the beach will also aid in protecting Camp Ellis and

the harbor from breakthrough of the sea between the west end of the north Saco River Jetty and Camp Ellis. The invertebrates that presently inhabit the existing beach and nearshore zones will quickly recolonize the new beach face formed by the nourishment sand. Since the organic content of the sandy material to be dredged is low, odors from hydrogen sulfide gas released from decaying material will be negligable. By the summer season any odor will not be noticeable due to reworking and washing of the sand by waves, currents and storms subsequent to disposal.

OTHER DREDGING IMPACTS

Dredging and other construction activities could conceivably have an impact on commercial and recreational use of the harbor. This impact could be minimized by dredging in late fall or winter.

Many biological impacts would also be minimized by late fall or winter dredging. Very few animals spawn in winter, and many species are dormant or buried.

PROBABLE IMPACTS OF ICEBREAKER CONSTRUCTION

Project activities associated with icebreaker construction have both short and long term implications. Physical activities associated with driving piles into the riverbed will cause a temporary and very minimal degradation of water quality due to the suspension of material in the water column. These temporary effects may occur during construction; however, conditions will return to normal once the project is completed and the surface of the icebreaker structures will provide additional habitat for the attachment of a variety of plants and animal life.

Longer term impacts will affect the economic, recreational and aesthetic resources of the project area. By implementing the proposed project, the commercial fishermen will be able to utilize the anchorage at Camp Ellis Harbor throughout the winter months, which should provide additional jobs and revenue for the community. The pile icebreakers will be permanent obstacles in the river that will have to be avoided. However, they are to be spaced far enough apart so that all boats in the anchorage should have no difficulty maneuvering around them. Overall, there are no major long term adverse impacts to the environment. The installation of the pilings will have little or no effect on existing or planned land use along the Saco River.

OTHER CONSTRUCTION IMPACTS

Noise

During the dredging operations, a problem with noise from the dredge and discharge pipe may arise. This is a short-term problem and can probably be treated as such if complaints arise. Noise is not expected to be a problem in this case as summer residents and tourists would not be present during the construction period.

Emplacement of the icebreaker pilings will be accomplished using hydraulic jetting equipment or a diesel pile driver. This equipment will make some noise. Summer residents and tourists would not be effected by this during the off season construction.

Atmospheric Conditions

Construction activities associated with the proposed action will have negligible direct impact on existing conditions. Diesel emissions from both the dredge pump and pile driver engines will be quickly dispelled by prevailing winds and are not judged to be significant.

Safety and Health Hazards

The safety of the construction site to humans and animals is dependent on the measures taken to restrict access to the area. During dredging and beach nourishment operations no one should have access to the dredging site. The beach area should be closed to the public until placement of the material is complete.

AFFECTED ENVIRONMENT

Marine Facilities

The Saco River (from Saco-Biddeford to the sea) serves as a harbor for fishing vessels, yachts, and small pleasure craft. Boating activities are centered around recreational uses. Both fishing and recreational boating compete for space at Camp Ellis.

There are no active commercial wharves at Saco or Biddeford other than the public dock at Camp Ellis. There are four major marine facilities located on the Saco River.[1] A description of these facilities is found in Appendix 1.

Hydrology

The Saco River estuary, from the river mouth to the tidewater dam in Biddeford-Saco, is a six mile bedrock channel with highly irregular bottom topography. The circulation within the estuary is controlled by fresh water flows in the Saco River and by tidal currents. On each flood tide, a salt water wedge moves approximately 4 miles upstream pooling the freshwater discharge until the end of flood when the ebb current carries the lighter freshwater over the salt wedge toward the ocean.[2] This estuary may be classified as a "horizontal to inclined salt wedge estuary"[3] which exhibits a highly stratified salt gradient with salinity ranging from 0 to 30 parts per thousand (ppt). Deep pockets within the bedrock channel have been observed to collect the higher saline water from a flood tide and retain this salt water through an entire tidal cycle until it is mixed with the salt water of the next flood.

The tide at Saco is semidiurnal. The mea tidal range is 8.7 feet. Mean high tide is 8.7 feet above the mean low water level and extreme low tide is 3.5 feet below the mean low water level. Storm surges up to 12.0 feet above mean low water can be expected at least once or twice yearly.[4]

As a result of the large tidal range and the narrowness of the Saco estuary, strong tidal currents exist in the estuary. During flood tide the deeper currents are stronger than the surface currents. Ebb current velocities have been observed to be greater than 3.0 knots on the surface with a turbulent mixing layer along the salt wedge. Maximum flood velocities of 2.5 knots were measured near the mouth of the river and in the vicinity of the deeper pockets in the channel bottom. From March to May heavy freshwater discharges to the estuary from the Saco River can increase the channel depths by as much as 8 feet above high water at Saco. This condition also causes dangerous currents, i.e. greater than 3.0 knots during ebb tide.

Water Quality Description of Saco River Estuary

The waters of the Saco River estuary are presently classified by the State of Maine as SC from the head of tide to the Camp Ellis breakwater.[5,6] As stated in the Maine Water Pollution Control Law, Class SC waters "shall be of such quality as to be satisfactory for recreational boating, fishing and other similar uses except primary water contact. Such waters may be used for the propagation of indigenous shellfish to be harvested for depuration purposes, for a fish and wildlife habitat, and for industrial cooling and process uses."

There are three major wastewater discharges to the estuarine portion of the Saco River, they include the Biddeford and Saco Municipal Sewer Treatment Plants and the treatment plant on Factory Island serving the Saco Tanning Corporation. In addition to the three major wastewater discharges described above, there is a secondary treatment plant at the Saco Industrial Park which treats 25,000 gallons per day of sanitary waste. The State of Maine has also licensed eight discharges of untreated sanitary wastes from residences along the estuary in both Biddeford and Saco.

The sand to be dredged under the proposed plan of improvement does not contain any high levels of organic material or other pollutants. Dredging and disposal and natural reworking and washing of disposed beach nourishment sand would not have any adverse environmental impact or release significant amounts of pollutants into the water column.

Tidal Marshes

The Saco River estuary has a 6-mile channel with limited saltmarsh or tidal flat development. There are approximately 304 acres of salt marsh, the most extensive areas occurring adjacent to Biddeford Pool.[7] The

salt marshes along the river are "fringe marshes" of predominantly Spartina alterniflora with eelgrass (Zostera marina) in the open water areas. There are no tidal marshes in the proposed project area.

Commercially and Recreationally Harvestible Shellfish

"Because of bacterial pollution, it is unlawful to dig or take in any manner or to have in possession any clams, quahogs, oysters, mussels, and other marine mollusks from the shores and flats of the Saco River and all tributaries including Biddeford Pool."[8] Closed shellfish areas include Biddeford Pool and areas west of a line extending from the end of the "breakwater" to the most northerly point of Fletcher Neck.[9]

Soft shell clams (Mya arenaria) are known to exist throughout the tidal areas of the Saco River estuary. A survey of soft clams revealed "poor" quantities (0 t 50 bushels/acre) in the Hills Beach Cove area and at Camp Ellis on both sides of the breakwater.[10] These high energy areas are characterized by moving sediments which result in high shellfish mortality and slow growth.

Finfish

The Saco River supports the largest recreational striped bass (Morone saxatilis) fishery of all Maine rivers.[11,12] Striped bass enter the river early to mid-May and remain through November. Fishing activity for stripers peaks during August and, although it tapers off significantly after Labor Day, extends through October. Striped bass are caught throughout the estuary. Although striped bass enter the river, they are not known to spawn in the estuary.

Atlantic mackerel (Scomber scombrus) enter the Saco River during July and August and provide the second most important recreational fishery. Mackerel are generally concentrated in the lower 2 miles of the estuary, with the majority of the fishing activity taking place at Camp Ellis and off the breakwaters.

Spawning runs of anadromous fish are blocked by the dams at Saco-Biddeford. Although two old fishways do exist, fish passage is negligible due to the lack of attraction water. There is presently a small spawning run of alewives (Alosa pseudoharengus) that enter the river during May and early June and spawn in the tailraces of the dams.

A resident population of white perch (Morone americana) is present in the upper reaches of the estuary. The sport fishery for this species is concentrated in the vicinity of Cow Island. American eels (Anguilla rostrata) are present throughout the estuary and provide an incidental fishery. Harbor pollack (Pollachius virens) and winter flounder (Pseudopleuronectes americanus) are also caught by sport fishermen in the lower to mid-estuarine reaches.

Rare and Endangered Species

Generally speaking, there are few rare, endangered or threatened species of fish and wildlife along the Maine coast.[13] A review of a survey of the occurrence of these species revealed that only the Atlantic sturgeon and Atlantic salmon may occur in the Saco River. Sturgeon have not been reported from the Saco River, but they can be expected to occur occasionally in the major Maine rivers. Atlantic salmon have been stocked in the Saco and, although salmon may occur the next few summers, the dams at Biddeford and Saco preclude the establishment of a naturally reproducing population.

COORDINATION ACTIVITIES

A list of those agencies, interested groups, and the public who were consulted in the preparation of this assessment is found in Appendix 3.

REFERENCES

ECONOMIC CONSEQUENCES

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2. Chen, K.Y. et al. 1976. Research study on the effect of dispersion, settling, and resedimentation on migration of chemical constituents during open-water disposal of dredged materials. U.S. Army Corps of Engineers Dredged Materials Research Program. Contract Report D-76-1.

3. Fulk, R., D. Gruber and R. Wullschleger. 1975. Laboratory study of the release of pesticide and PCB materials to the water column during dredging and disposal operations. U.S. Army Corps of Engineers Dredged Material Research Program Contract Report D-75-6.

4. Pfitzenmeyer, H. 1970. Gross physical and biological effects of overboard spoil disposal in upper Chesapeake Bay. Benthos. Special Report No. 3, Natural Resources Institute, University of Maryland.

Affected Environment

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2. Farrell, Stewart, Sediment Distribution and Hydrodynamics, Saco River and Scarboro Estuaries, Maine, Office of Naval Research, No. 6-CRG, 1970.

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4. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Survey, Hydrographic Chart No. 13287 - Saco Bay and Vicinity.

5. Department of the Army, Corps of Engineers, Saco River Project File.

6. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Survey, United States Coast Pilot 1, Atlantic Coast Eastport to Cape Cod, 13th edition, November, 1976.

7. State of Maine, Department of Environmental Protection, Classification of Surface Waters, October, 1975.

8. The Saco River Environmental Advisory Committee, Saco River Corridor, The View for the Valley, April, 1973.

9. Reed and D'Andrea, Conservation priorities plan, coastal overview, Reed and D'Andrea, South Gardiner, Maine, unpublished draft, 1973.

10. Flagg, Lewis, Maine Department of Marine Resources, personal communication.

11. DeRoche, Stuart, Maine Department of Inland Fisheries, personal communication.

12. Public Notice, April 5, 1972, State of Maine Department of Sea and Shore Fisheries.

13. Wallace, Dana, Maine Department of Marine Resources, personal communication.

FINDING OF NO SIGNIFICANT IMPACT

After careful consideration of the information presented in this Environmental Assessment, it is my conclusion that development of the proposed project is in the best overall public interest, and can be accomplished with a minimum of environmental impact.

Points considered include the effects of installing the ice breaker pilings, dredging the anchorage and placing the dredged materials on the Camp Ellis beach north of the jetty. Effects of the ice breaker installation are best expressed in a letter from the U.S. Fish and Wildlife Service dated 16 January 1979 which stated that the loss of a small amount of benthic habitat is expected to be more than offset by plant and animal communities that will become attached to intertidal and subtidal portions of the pilings. The project also provides for an osprey nesting platform on one of the piles at their suggestion. Sand grain size and the use of a hydraulic dredge will minimize turbidity at the anchorage site during construction so that impact, will be minimum. The deposition of the dredged material on Camp Ellis beach will enhance the eroded beach and provide for additional shorefront property protection.

In my evaluation, this assessment has been prepared in accordance with the National Environmental Policy Act of 1969. It appears that this project can be built and utilized with minimal environmental impacts, based on the temporary nature of the construction activities and the development of the anchorage.

The determination that an Environmental Impact Statement is not required is based on the information contained in the Environmental Assessment and the following considerations:

1. Nourishment of the eroded Camp Ellis Beach will enhance its appearance and provide additional shorefront protection.

2. Installation of the icebreaker structures will provide additional habitat for the plant and animal communities.

3. Coordination with appropriate Federal and State agencies insured that concerns and suggestions were made known to the Corps so that these concerns could be addressed during project planning.

1 December 1981
DATE

C.E. EDGAR, III
Colonel, Corps of Engineers
Division Engineer

CONCLUSIONS

As Division Engineer of the New England Division, Corps of Engineers, I have reviewed and evaluated in the overall public interest all pertinent data concerning the proposed plan of improvement, as well as the stated views of other agencies and the concerned public, relative to the practical alternatives in providing navigation, improvements in the Saco River at Camp Ellis Harbor, Saco, Maine.

The possible consequences of alternatives have been studied according to engineering feasibility, environmental impacts, economic factors of regional and national resource development and other considerations of social well-being and the public interest. The ramifications of these issues have been considered in detail in the formulation of this plan of improvement as outlined in this report.

In summary, there are substantial benefits to be derived by providing the present and anticipated commercial vessels in Camp Ellis Harbor with a safe year-round navigational system.

It is noted that the improvement would cause a minor disruption of the environment during construction of the anchorage and placement of the icebreakers. However, as those impacts are not considered significant, an Environmental Assessment has been performed in lieu of an Environmental Impact Statement. Due to the significant benefits attributable to the commercial fishing industry, it is considered that this adverse environmental effect would be more than offset by the improvement in the overall economic growth of the region.

I find that the proposed action, as developed in this report, is based on a thorough analysis and evaluation of various practicable alternative courses of action for achieving the stated objective, that wherever adverse effects are found to be involved, they cannot be avoided by following reasonable alternatives and still achieve the specified purposes; that where the proposed action has an adverse effect, this effect is either ameliorated or substantially outweighted by other considerations. The recommended action is consistent with national policy, statutes, and administrative directives, and should best serve the interests of the general public.

RECOMMENDATION

The Division Engineer recommends that modification of the existing Federal navigation project at Camp Ellis Harbor, Saco River, Saco, Maine be authorized by the Chief of Engineers under the provisions of Section 107 of the River and Harbor Act of 1960, as amended.

The project would provide for a 3 acre anchorage 6 feet (MLW) deep protected by a series of 11 icebreaker structures and two icebreakers for protection of the city pier at a cost $237,700. Since the benefits attributable to the improvement are entirely commercial in nature, the entire cost of construction as well as all future maintenance costs will be borne by the Federal Government.

The recommendation is made subject to the conditions that local interests will:

(1) Provide, maintain and operate without cost to the United States, an adequate public landing with provisions for the sale of motor fuel, lubricants and potable water open and available to the use of all on equal terms.

(2) Provide without cost to the United States all necessary lands, easements and rights-of-way required for construction and subsequent maintenance of the project including suitable dredged material disposal areas with necessary retaining dikes, bulkheads and embankments therefor.

(3) Hold and save the United States free from damages that may result from construction and maintenance of the project.

(4) Accomplish without cost to the United States alterations and relocations as required in sewer, water supply, drainage and other utility facilities.

(5) Provide and maintain berths, floats, piers, and similar marina and mooring facilities as needed for transient and local vessels as well as necessary access roads, parking areas and other needed public use shore facilities open and available to all on equal terms. Only minimum, basic facilities and service are required as part of the project. The actual scope or extent of facilities and services provided over and above the required minimum is a matter of local decision. The manner of financing such facilities and services is a local responsibility.

(6) Assume full responsibility for all project costs in excess of the Federal cost limitation of $2,000,000.

(7) Establish regulations prohibiting the discharge of untreated sewage, garbage, and other pollutants in the waters of the harbor use thereof, which regulations shall be in accordance with applicable laws, regulations of Federal, State and local authorities responsible for pollution prevention and control.

ACKNOWLEDGEMENT AND IDENTIFICATION OF PERSONNEL

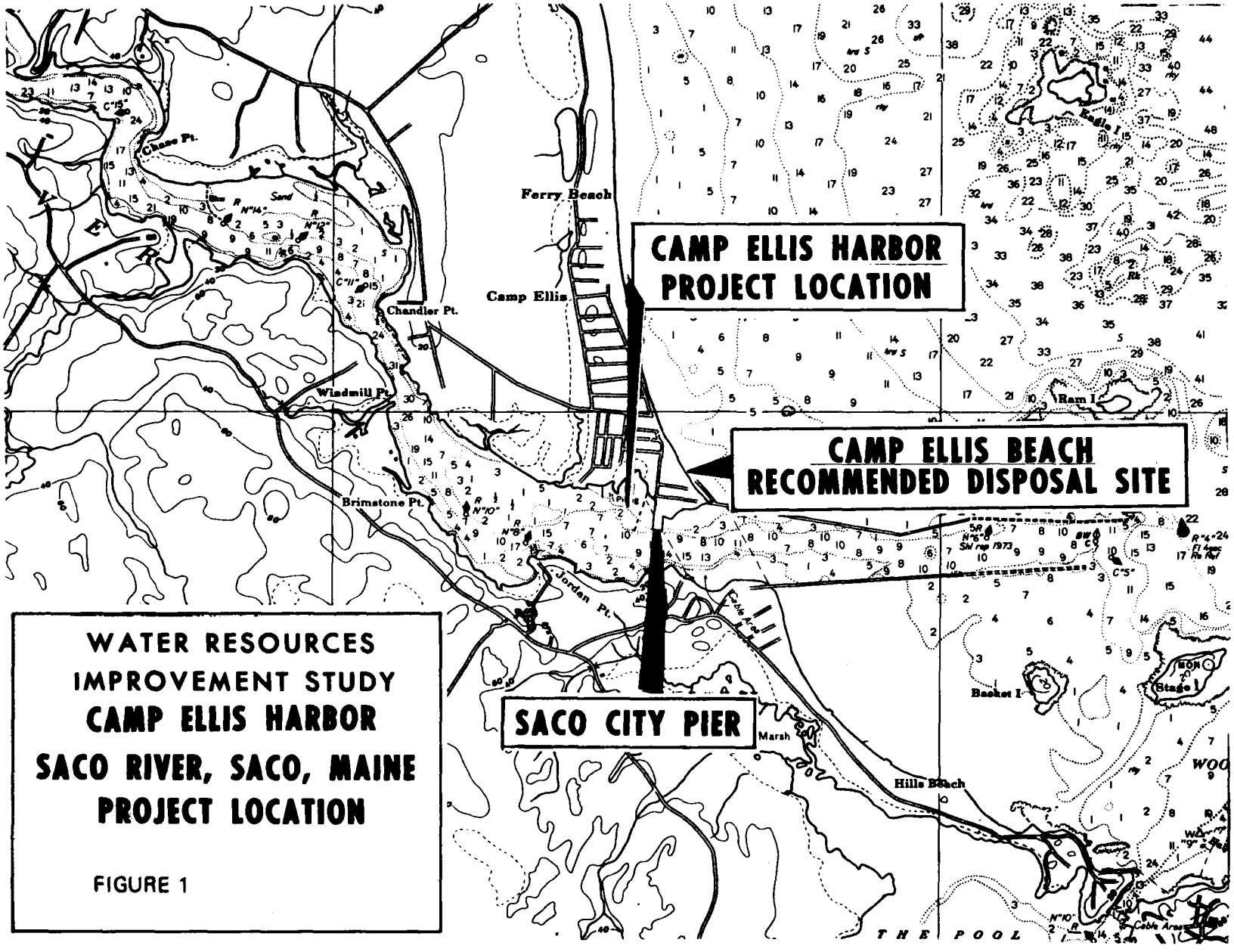
The preparation of this report was administered by:

Colonel C.E. Edgar, III, Division Engineer
Joseph L. Ignazio, Chief, Planning Division
Donald W. Martin, Chief, Coastal Development Branch
Richard DeSimone, Chief, Small Navigation Projects Section

Study management was directed by Project Manager, Michael Misslin. The economic and social analysis was performed by Mr. John J. Barry. The engineering analyses were performed under the direction of Mr. Anthony F. Mancini. Assisting in the development of this study were Lt. Robert Ganley and Mark Habel, Assistant Project Managers.

The New England Division is appreciative of the cooperation and assistance rendered in connection with this study by personnel of other Federal offices and agencies; by State and municipal authorities; and particularly the following:

U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire
Maine State Department of Transportation
City of Saco, Maine
University of Maine
Ocean Surveys, Inc., Old Saybrook, Connecticut
Dale E. Caruthers Company, Gorham, Maine



WATER RESOURCES
IMPROVEMENT STUDY
CAMP ELLIS HARBOR
SACO RIVER, SACO, MAINE
PROJECT LOCATION

FIGURE 1

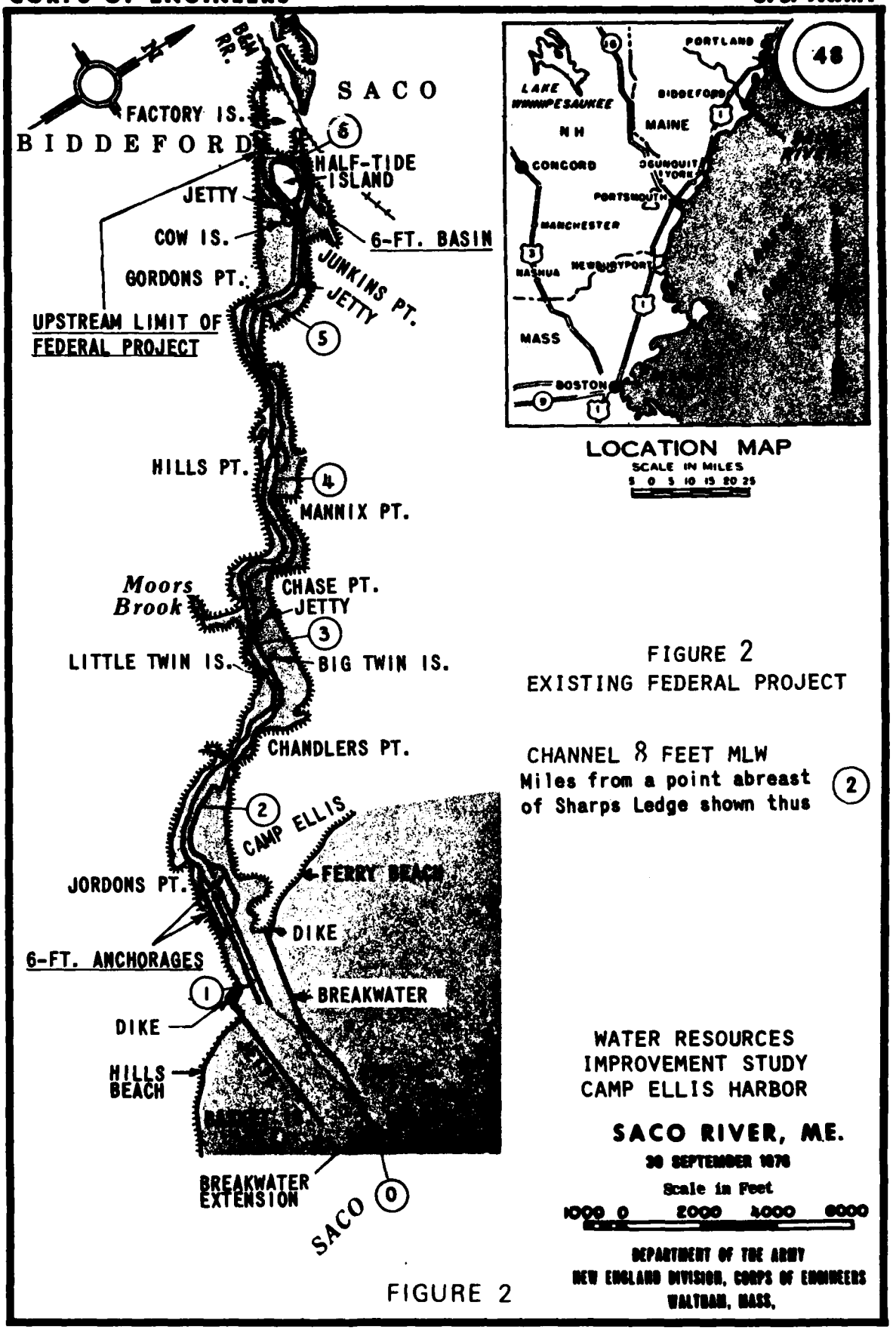
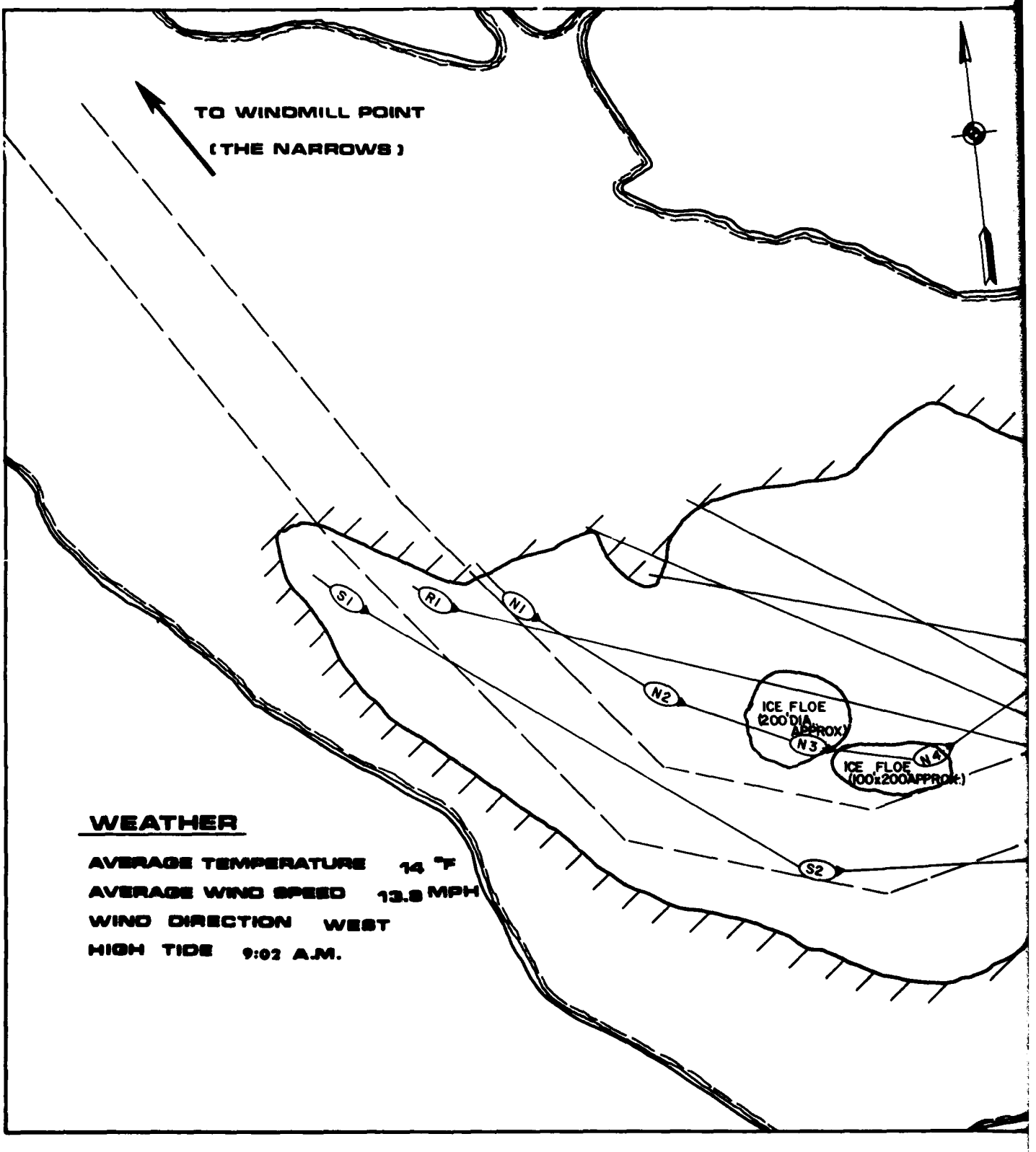

SACO
BIDDEFORD
FACTORY IS.
HALF-TIDE ISLAND
JETTY
COW IS.
6-FT. BASIN
GORDONS PT.
JUNKINS PT.
JETTY
UPSTREAM LIMIT OF FEDERAL PROJECT
HILLS PT.
MANNIX PT.
Moors Brook
CHASE PT.
JETTY
LITTLE TWIN IS.
BIG TWIN IS.
CHANDLERS PT.
CAMP ELLIS
JORDONS PT.
FERRY BEACH
DIKE
6-FT. ANCHORAGES
BREAKWATER
DIKE
HILLS BEACH
BREAKWATER EXTENSION
SACO
6
5
4
3
2
1
0
LAKE WINNIPESAUKEE
NH
MAINE
CONCORD
PORTLAND
BIDDEFORD
SOUNQUIT
YORK
PORTSMOUTH
MANCHESTER
NASHUA
NEWBURYPORT
MASS
BOSTON
LOCATION MAP
SCALE IN MILES
5 0 5 10 15 20 25
FIGURE 2
EXISTING FEDERAL PROJECT
CHANNEL 8 FEET MLW
Miles from a point abreast of Sharps Ledge shown thus (2)
WATER RESOURCES IMPROVEMENT STUDY
CAMP ELLIS HARBOR
SACO RIVER, ME.
30 SEPTEMBER 1976
Scale in Feet
1000 0 2000 4000 6000
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

FIGURE 2


TO WINDMILL POINT
(THE NARROWS)
S1
R1
N1
N2
N3
N4
ICE FLOE
(200' DIA APPROX.)
ICE FLOE
(100'x200' APPROX.)
S2
WEATHER
AVERAGE TEMPERATURE 14 °F
AVERAGE WIND SPEED 13.8 MPH
WIND DIRECTION WEST
HIGH TIDE 9:02 A.M.

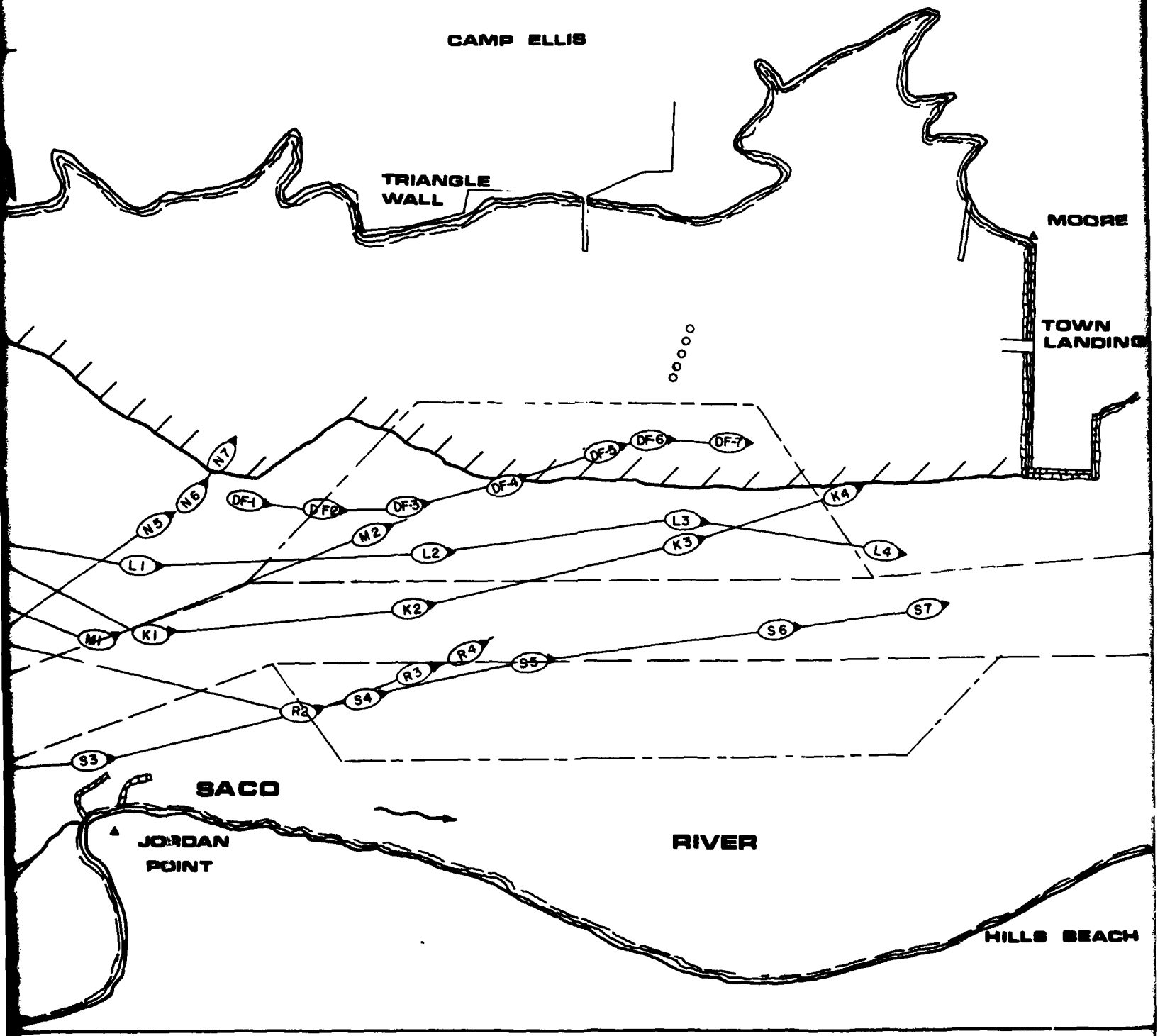

CAMP ELLIS
TRIANGLE WALL
MOORE
TOWN LANDING
N7
N6
N5
L1
M1
K1
DF-1
DF-2
DF-3
DF-4
DF-5
DF-6
DF-7
M2
L2
K2
K3
K4
L3
L4
S7
S6
S5
R4
R3
S4
R2
S3
SACO
JORDAN POINT
RIVER
HILLS BEACH

FIGURE 3

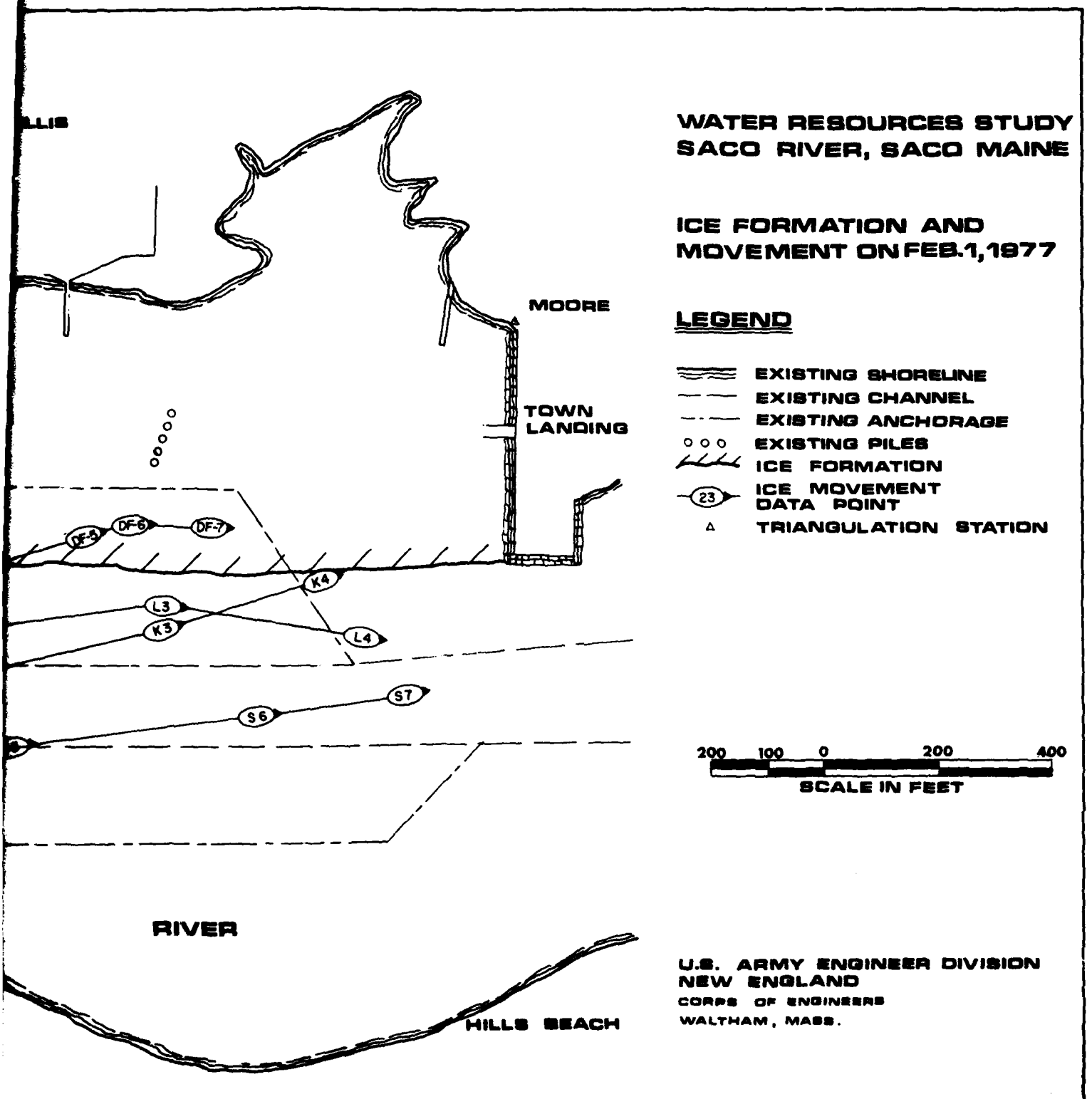
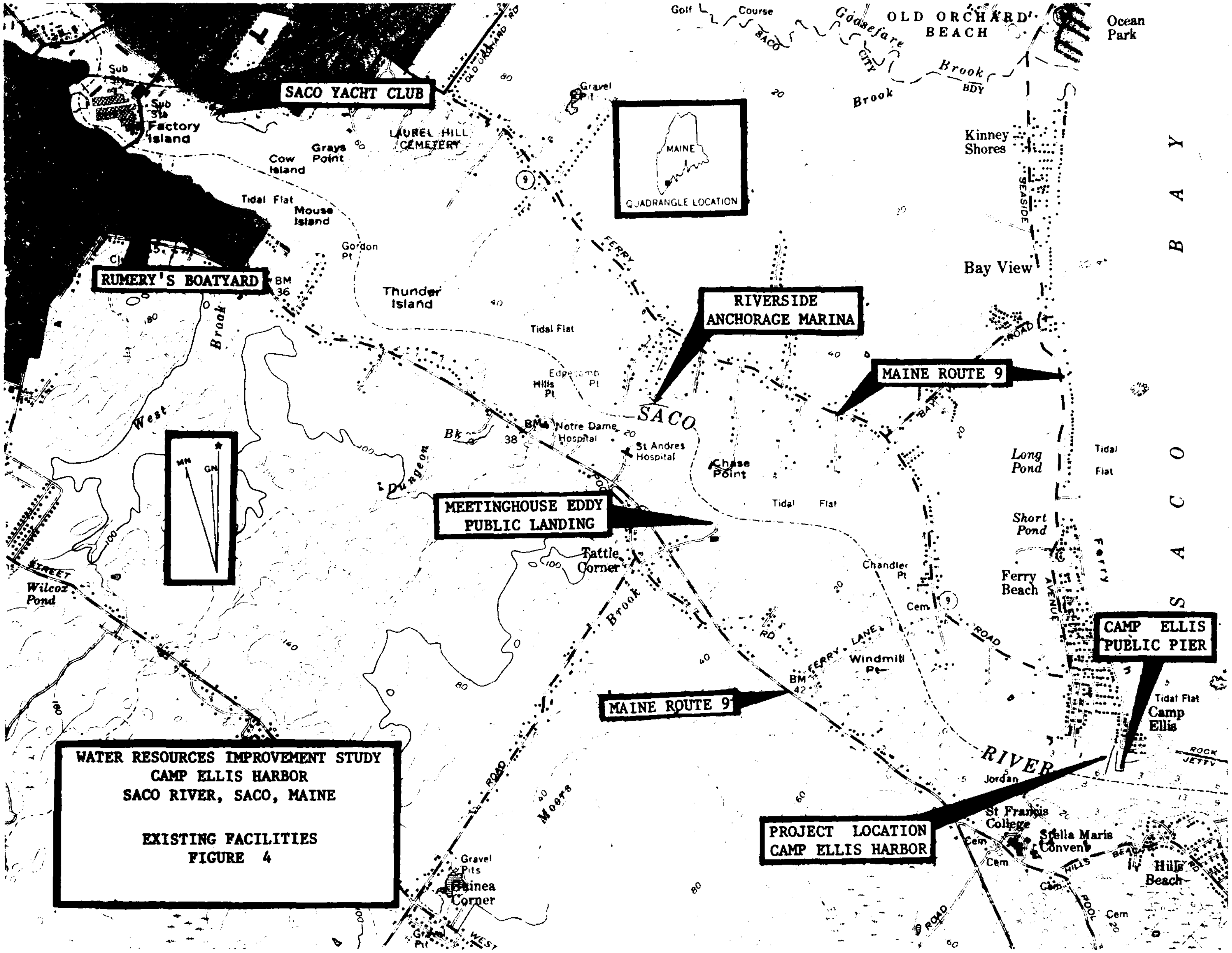

WATER RESOURCES STUDY
SACO RIVER, SACO MAINE
ICE FORMATION AND
MOVEMENT ON FEB. 1, 1977
LEGEND
EXISTING SHORELINE
EXISTING CHANNEL
EXISTING ANCHORAGE
EXISTING PILES
ICE FORMATION
23
ICE MOVEMENT DATA POINT
TRIANGULATION STATION
MOORE
TOWN LANDING
DF-5
DF-6
DF-7
K4
L3
K3
L4
S7
S6
200 100 0 200 400
SCALE IN FEET
RIVER
HILLS BEACH
U.S. ARMY ENGINEER DIVISION
NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

FIGURE 3



WATER RESOURCES IMPROVEMENT STUDY
CAMP ELLIS HARBOR
SACO RIVER, SACO, MAINE

EXISTING FACILITIES
FIGURE 4

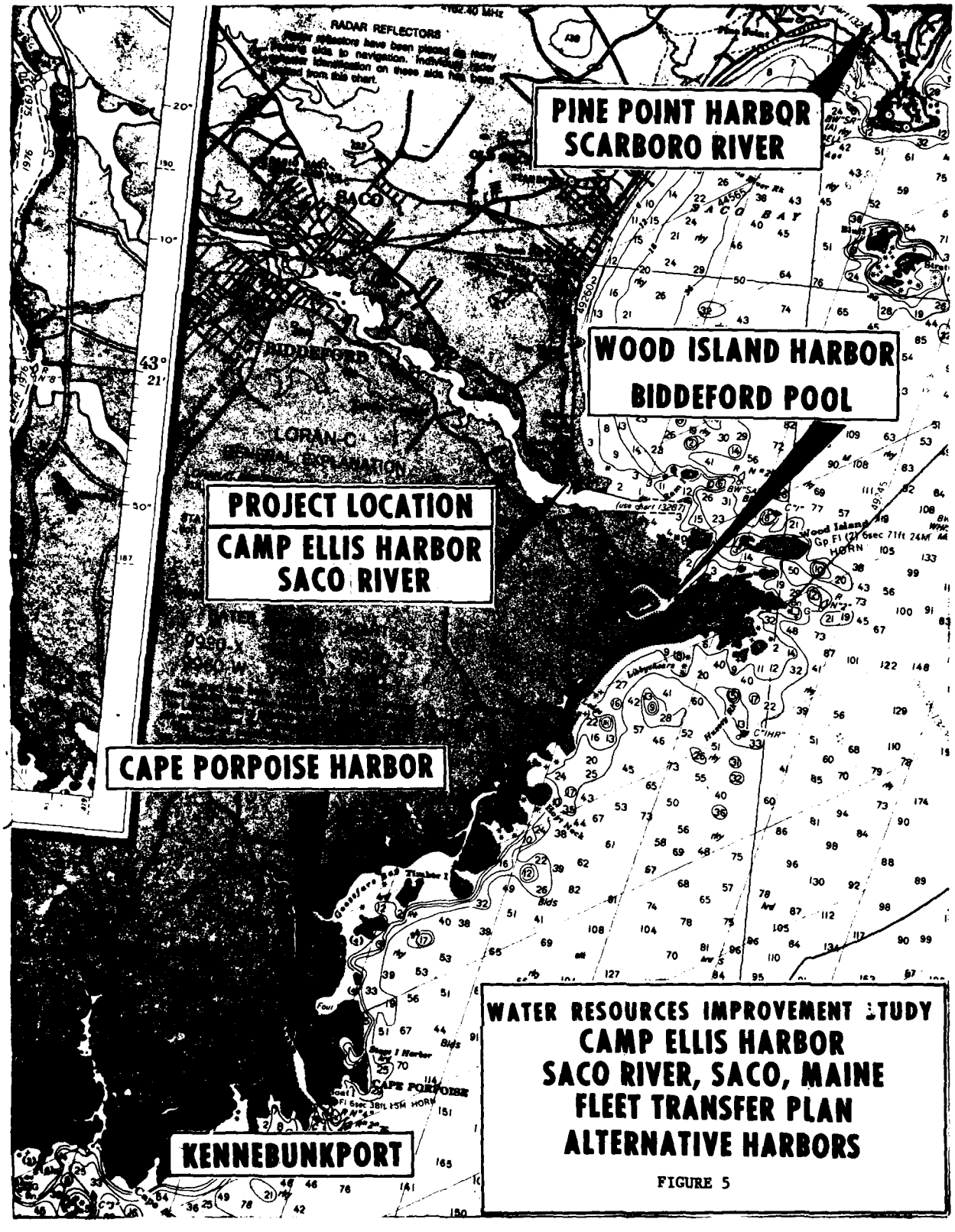
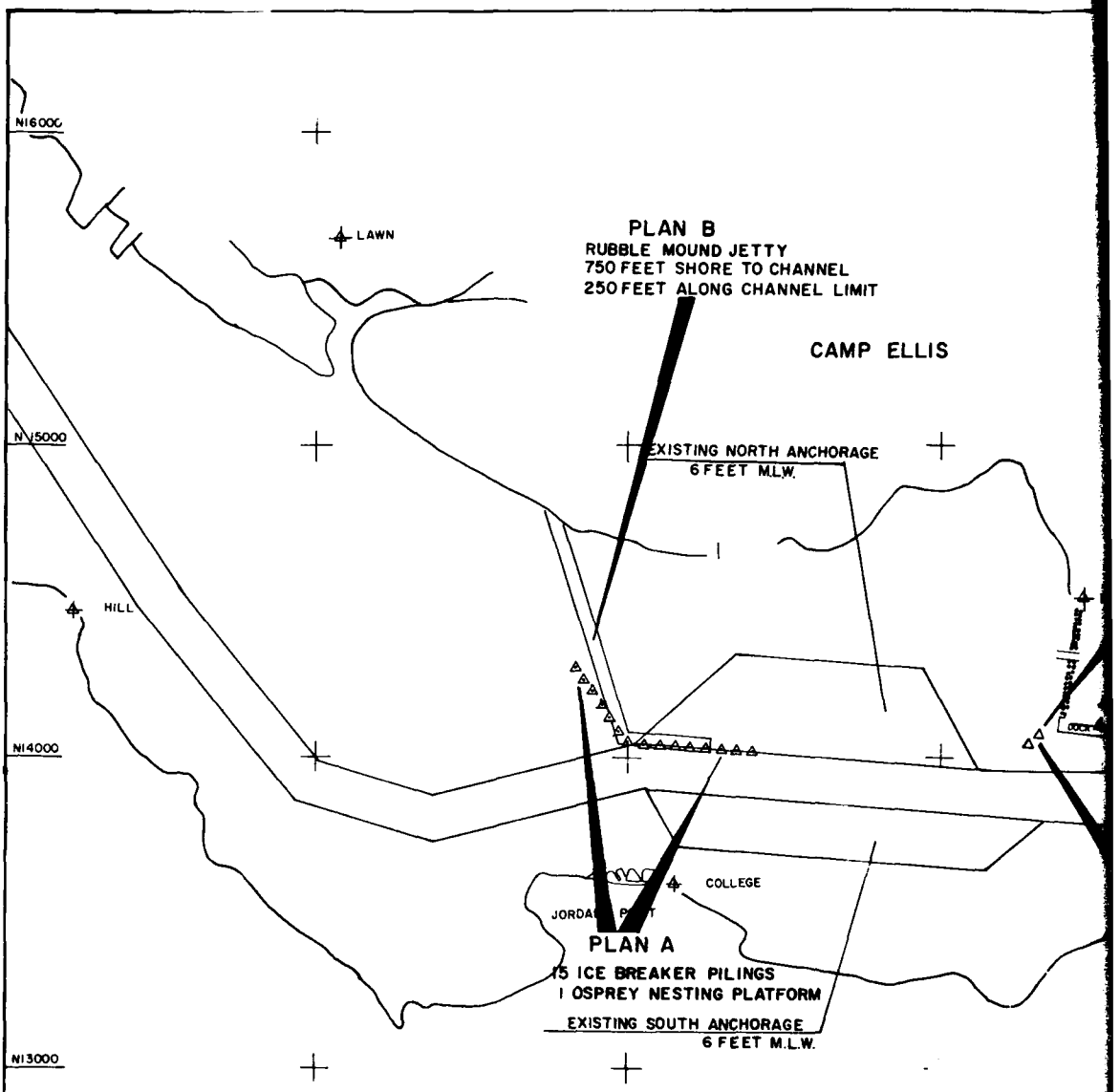
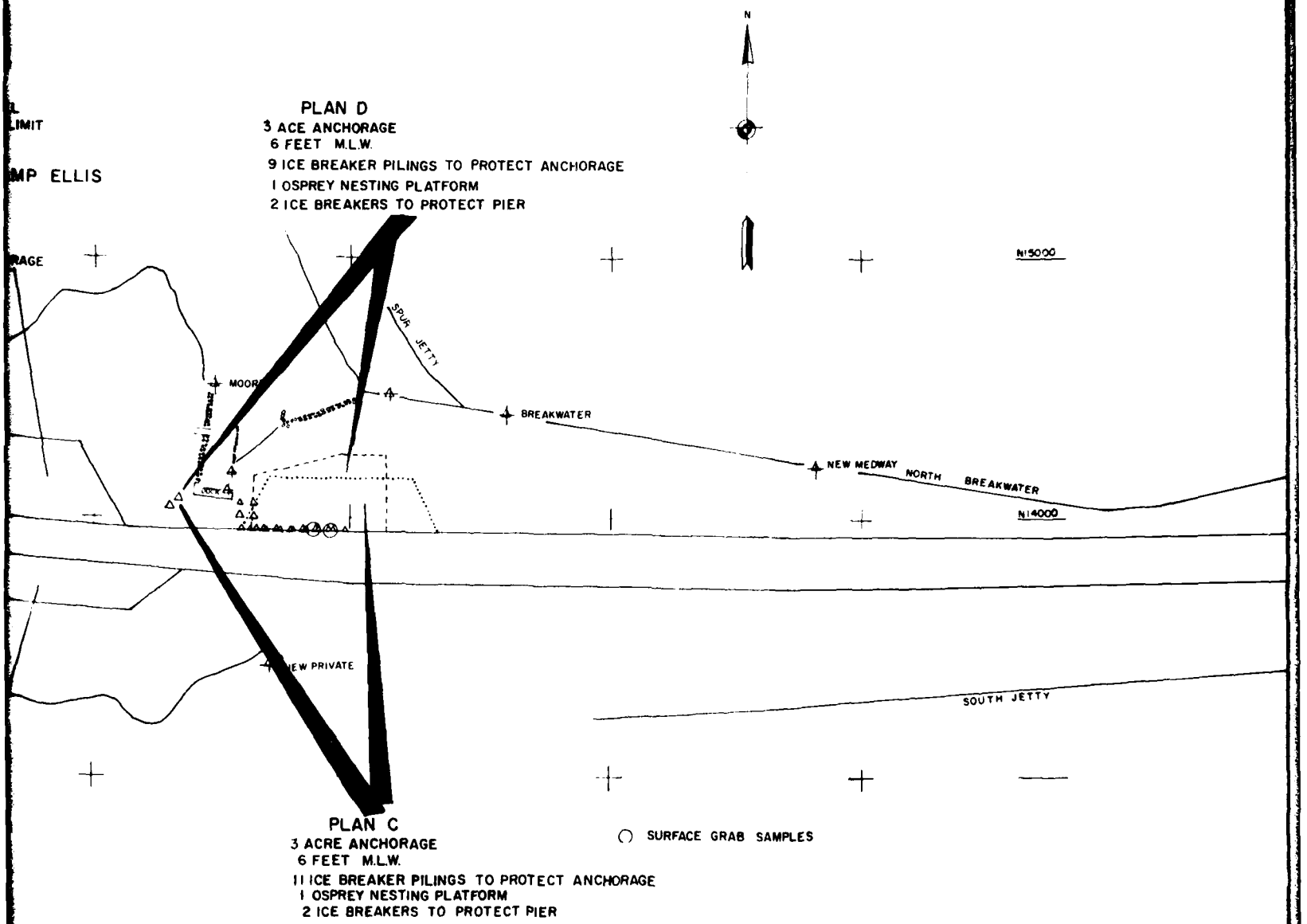

PINE POINT HARBOR
SCARBORO RIVER
WOOD ISLAND HARBOR
BIDDEFORD POOL
PROJECT LOCATION
CAMP ELLIS HARBOR
SACO RIVER
CAPE PORPOISE HARBOR
KENNEBUNKPORT
WATER RESOURCES IMPROVEMENT STUDY
CAMP ELLIS HARBOR
SACO RIVER, SACO, MAINE
FLEET TRANSFER PLAN
ALTERNATIVE HARBORS

FIGURE 5

CORPS OF ENGINEERS





WATER RESOURCES IMPROVEMENT STUDY

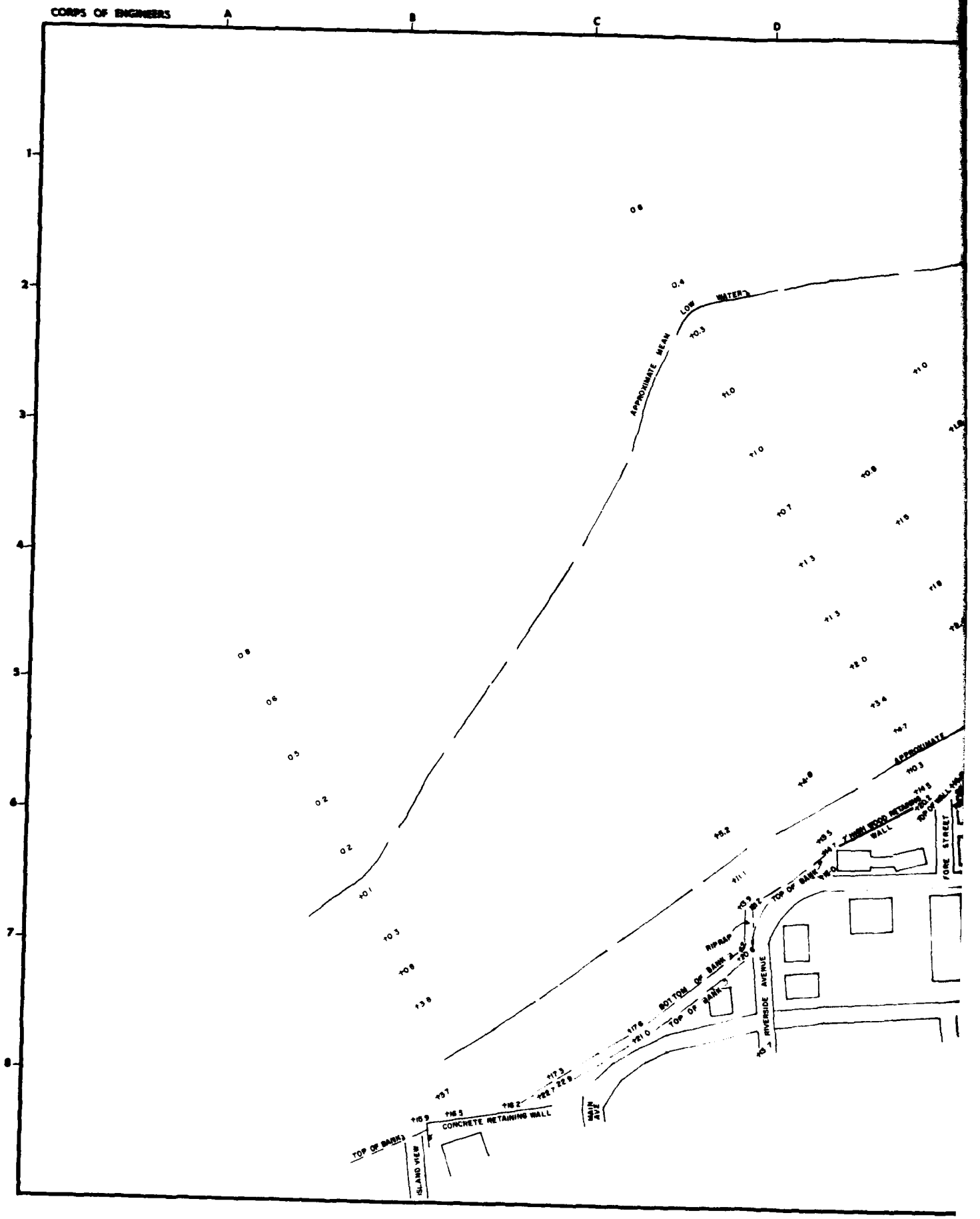
CAMP ELLIS HARBOR

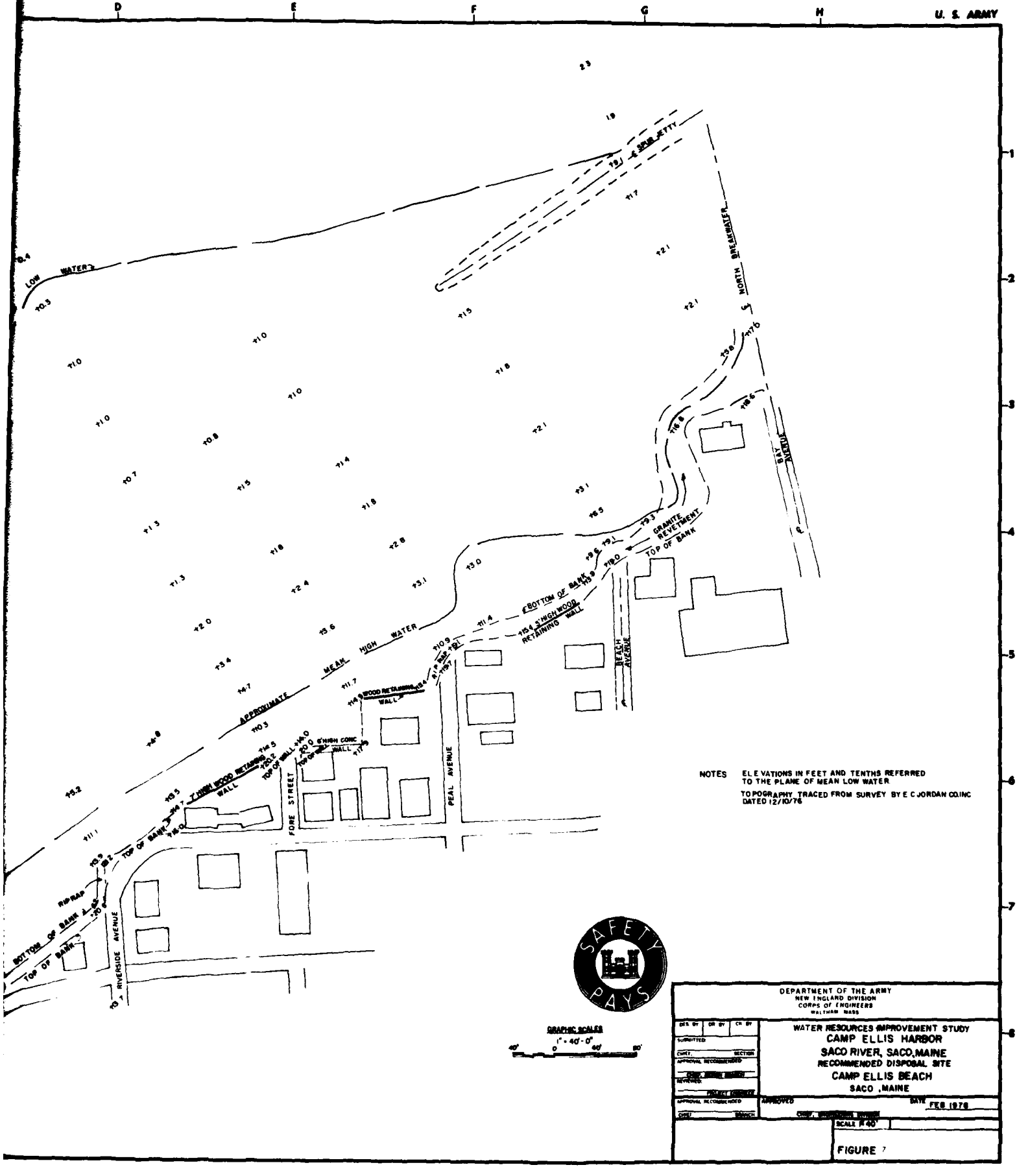
SACO RIVER, SACO, MAINE
ALTERNATIVE PLANS
OF IMPROVEMENT

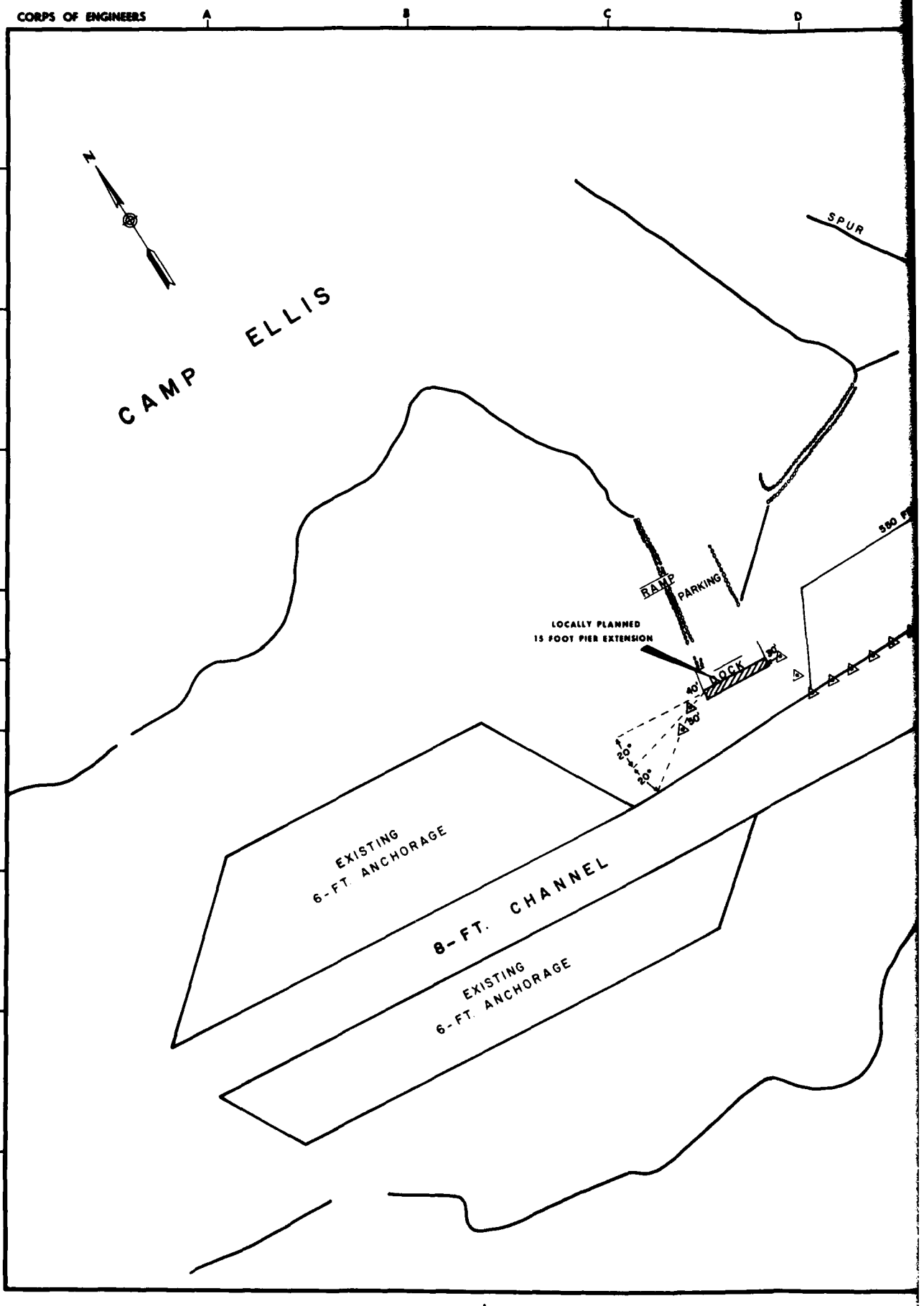
FIGURE 8

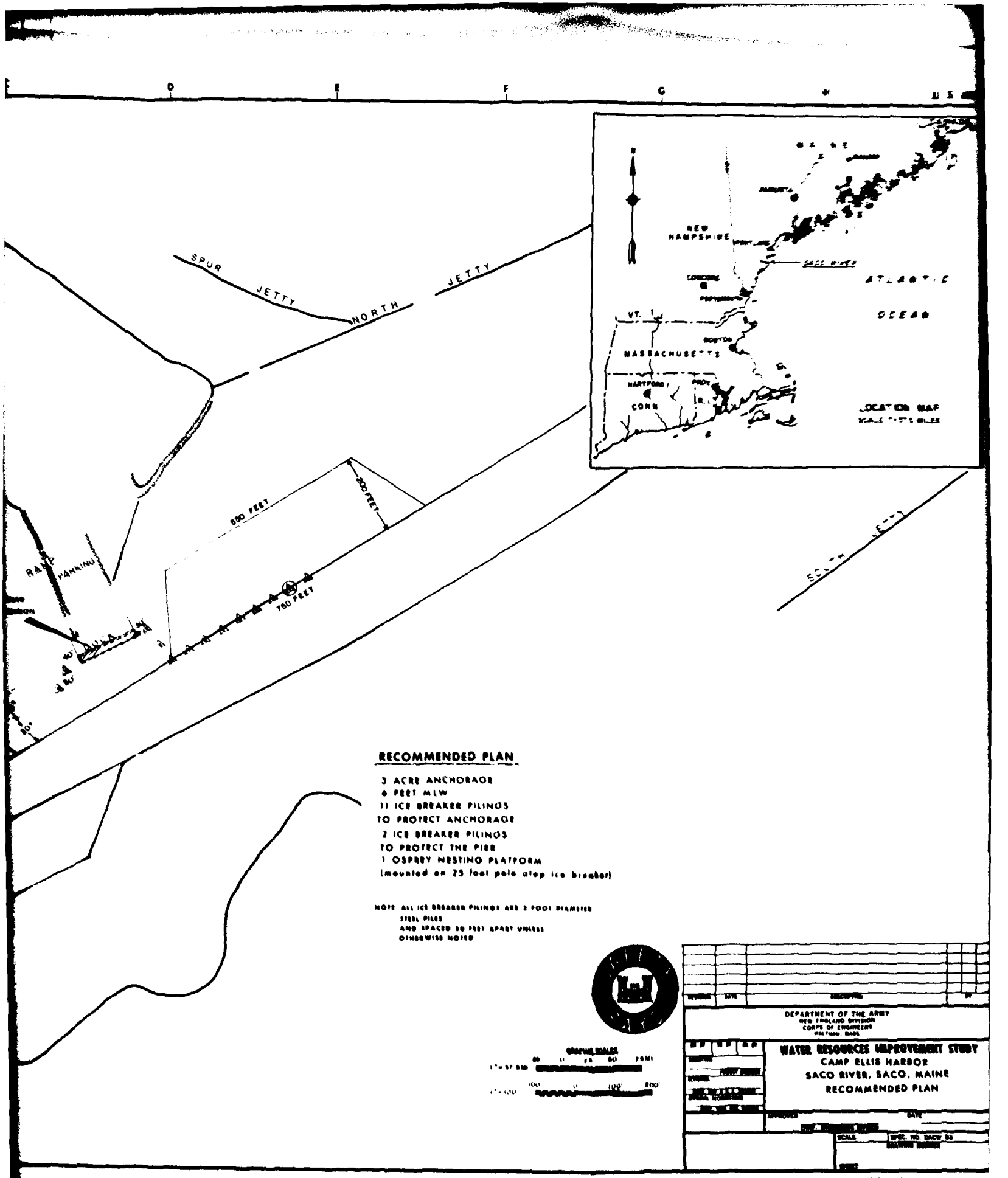
1

2


CORPS OF ENGINEERS
A
B
C
D
1
2
3
4
5
6
7
8
APPROXIMATE MEAN LOW WATER
RIPRAP
TOP OF BANK
BOTTOM OF BANK
CONCRETE RETAINING WALL
RIVERSIDE AVENUE
ISLAND VIEW
MAIN AVE
FORE STREET


D
E
F
G
H
U. S. ARMY
1
2
3
4
5
6
7
8
LOW WATER
SPUR JETTY
N. BREAKWATER
GRANITE REVETMENT
TOP OF BANK
BOTTOM OF BANK
MEAN HIGH WATER
APPROXIMATE
5'HIGH WOOD RETAINING WALL
5'HIGH CONC WALL
FORE STREET
PEAL AVENUE
BEACH AVENUE
BAY AVENUE
RIVERSIDE AVENUE
RIPRAP
NOTES
ELEVATIONS IN FEET AND TENTHS REFERRED TO THE PLANE OF MEAN LOW WATER.
TOPOGRAPHY TRACED FROM SURVEY BY E C JORDAN CO INC DATED 12/10/76
SAFETY PAYS
GRAPHIC SCALE
1" = 40'-0"
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM MASS
WATER RESOURCES IMPROVEMENT STUDY
CAMP ELLIS HARBOR
SACO RIVER, SACO, MAINE
RECOMMENDED DISPOSAL SITE
CAMP ELLIS BEACH
SACO, MAINE
APPROVED
DATE FEB 1978
SCALE 1"=40'
FIGURE 7


CORPS OF ENGINEERS
A
B
C
D
1
2
3
4
5
6
7
8
N
CAMP ELLIS
SPUR
RAMP
PARKING
LOCALLY PLANNED
15 FOOT PIER EXTENSION
DOCK
40'
30'
20'
20'
EXISTING
6-FT. ANCHORAGE
8-FT. CHANNEL
EXISTING
6-FT. ANCHORAGE



RECOMMENDED PLAN

3 ACRE ANCHORAGE
6 FEET MLW
11 ICE BREAKER PILINGS
TO PROTECT ANCHORAGE
2 ICE BREAKER PILINGS
TO PROTECT THE PIER
1 OSPREY NESTING PLATFORM
(mounted on 25 foot pole atop ice breaker)

NOTE: ALL ICE BREAKER PILINGS ARE 2 FOOT DIAMETER STEEL PILES AND SPACED 30 FEET APART UNLESS OTHERWISE NOTED

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS

WATER RESOURCES IMPROVEMENT STUDY
CAMP ELLIS HARBOR
SACO RIVER, SACO, MAINE
RECOMMENDED PLAN

FIGURE 8

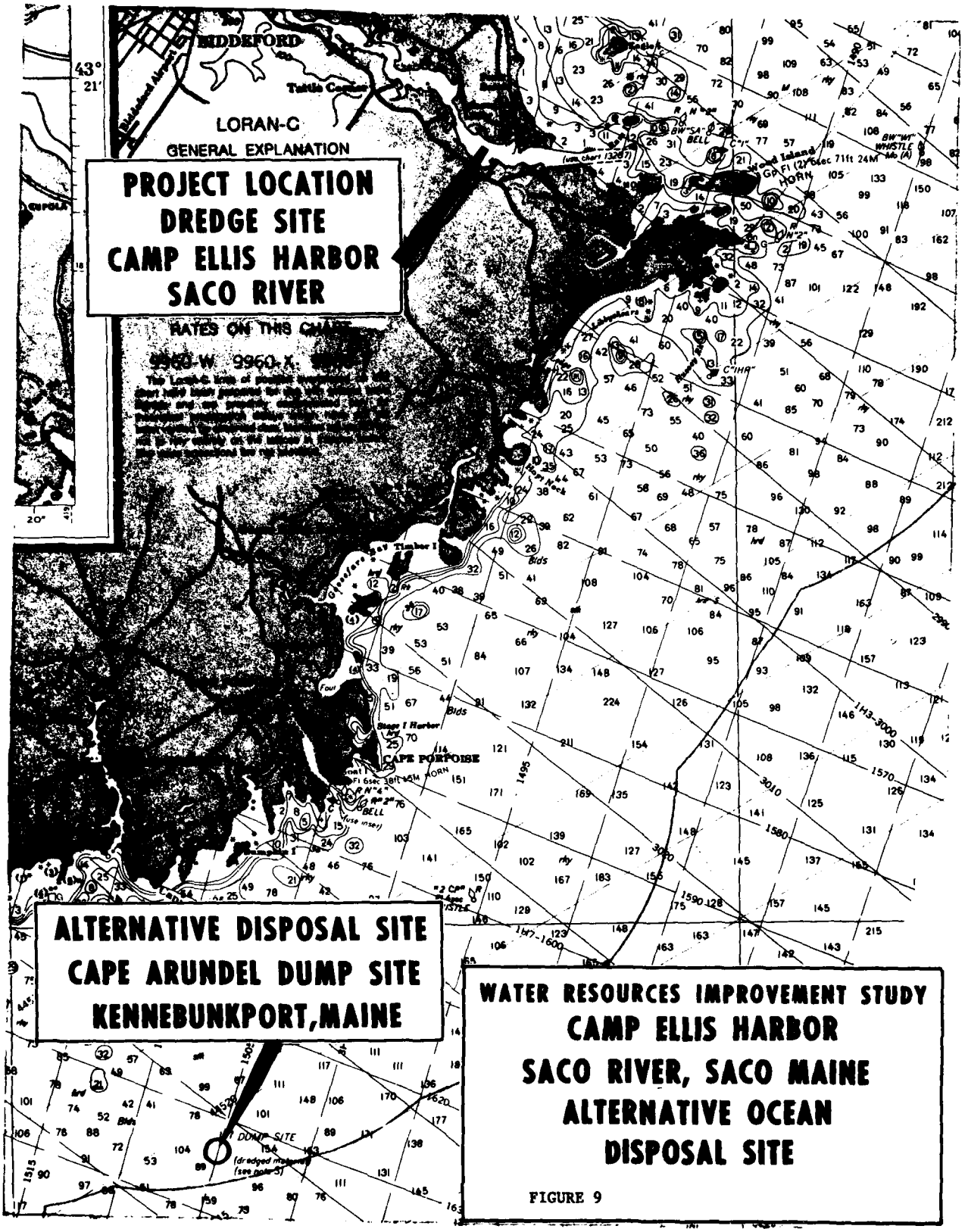
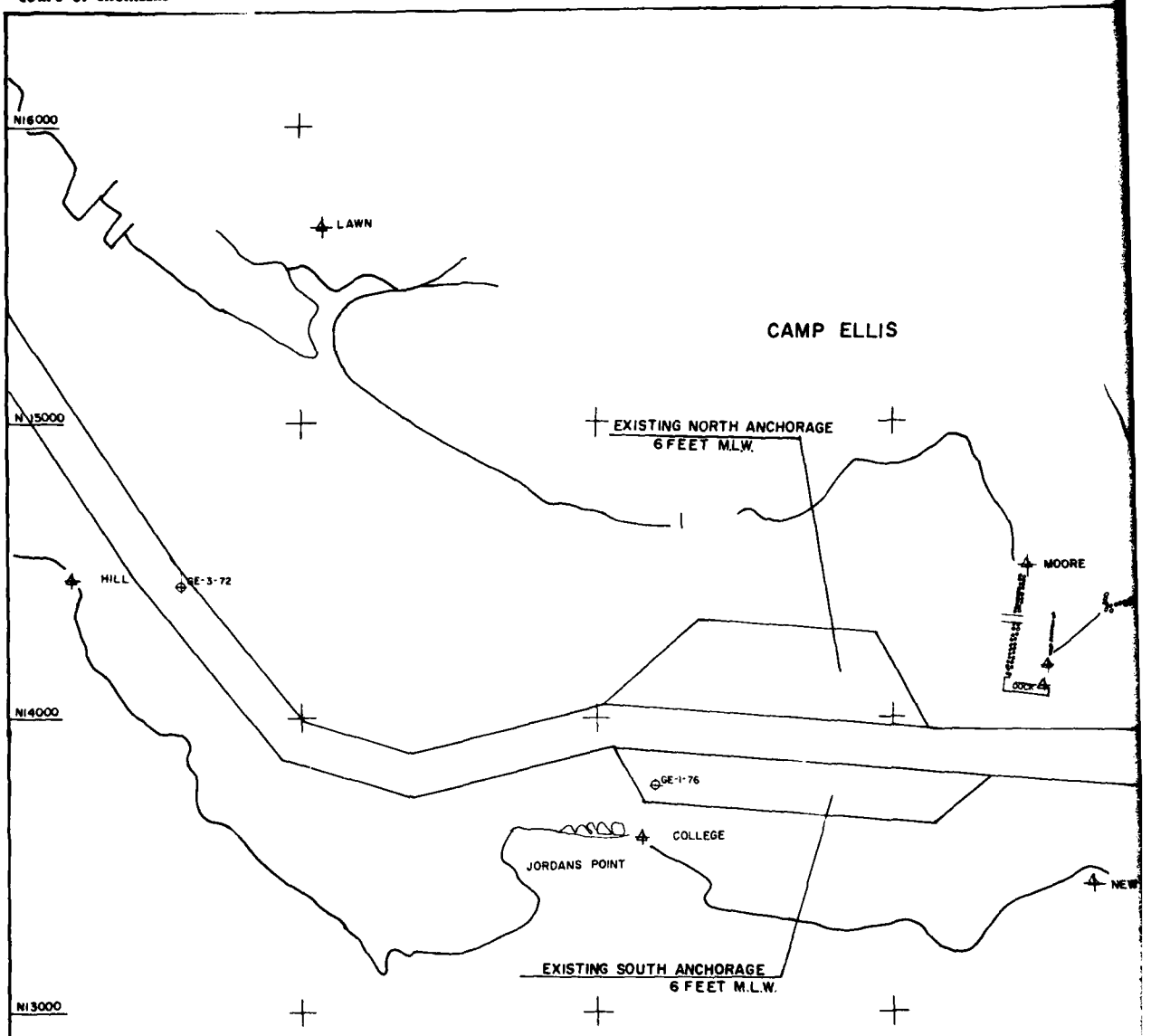
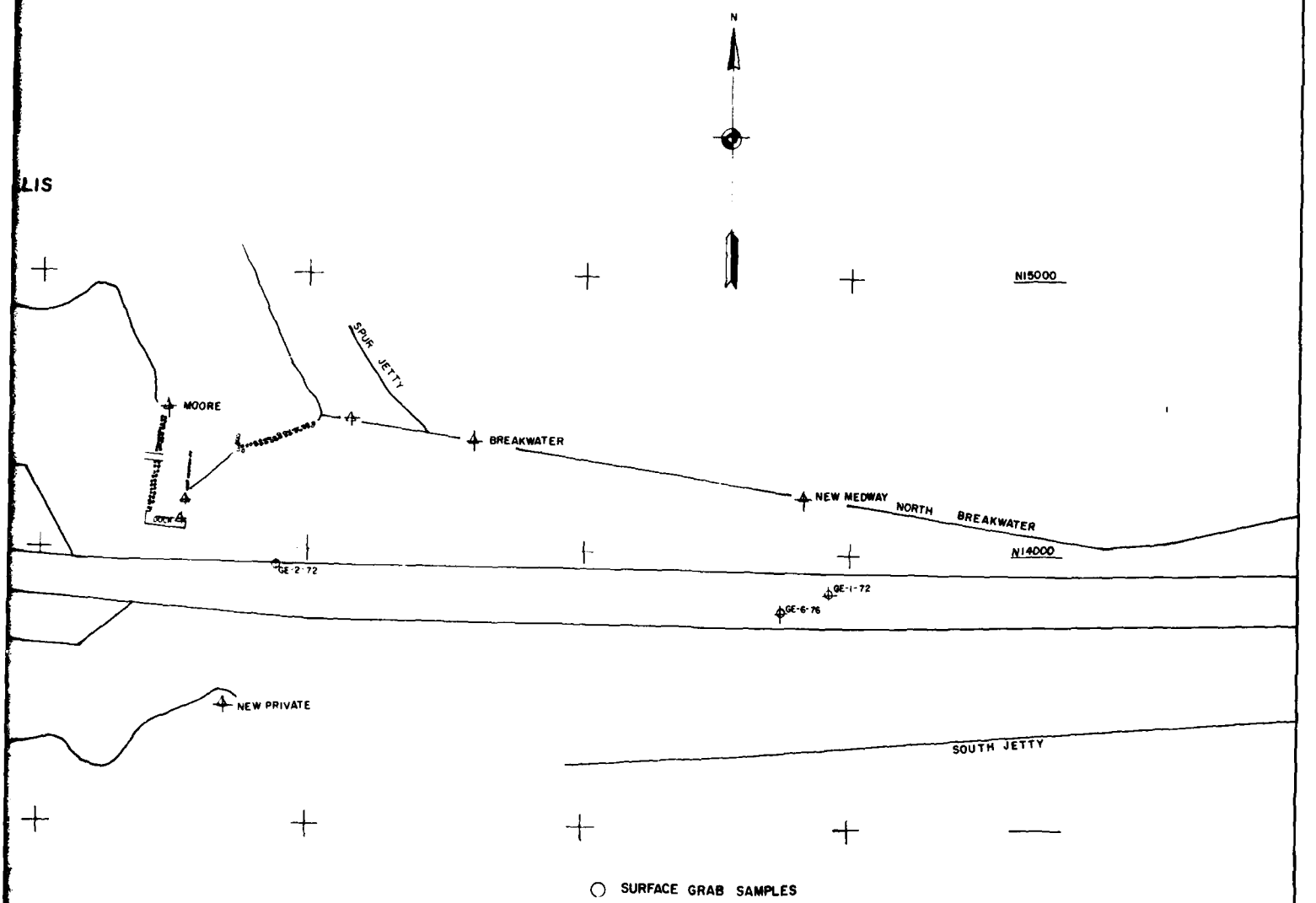

LORAN-C
GENERAL EXPLANATION
PROJECT LOCATION
DREDGE SITE
CAMP ELLIS HARBOR
SACO RIVER
ALTERNATIVE DISPOSAL SITE
CAPE ARUNDEL DUMP SITE
KENNEBUNKPORT, MAINE
DUMP SITE
CAPE PORPOISE
WATER RESOURCES IMPROVEMENT STUDY
CAMP ELLIS HARBOR
SACO RIVER, SACO MAINE
ALTERNATIVE OCEAN
DISPOSAL SITE

FIGURE 9

CORPS OF ENGINEERS



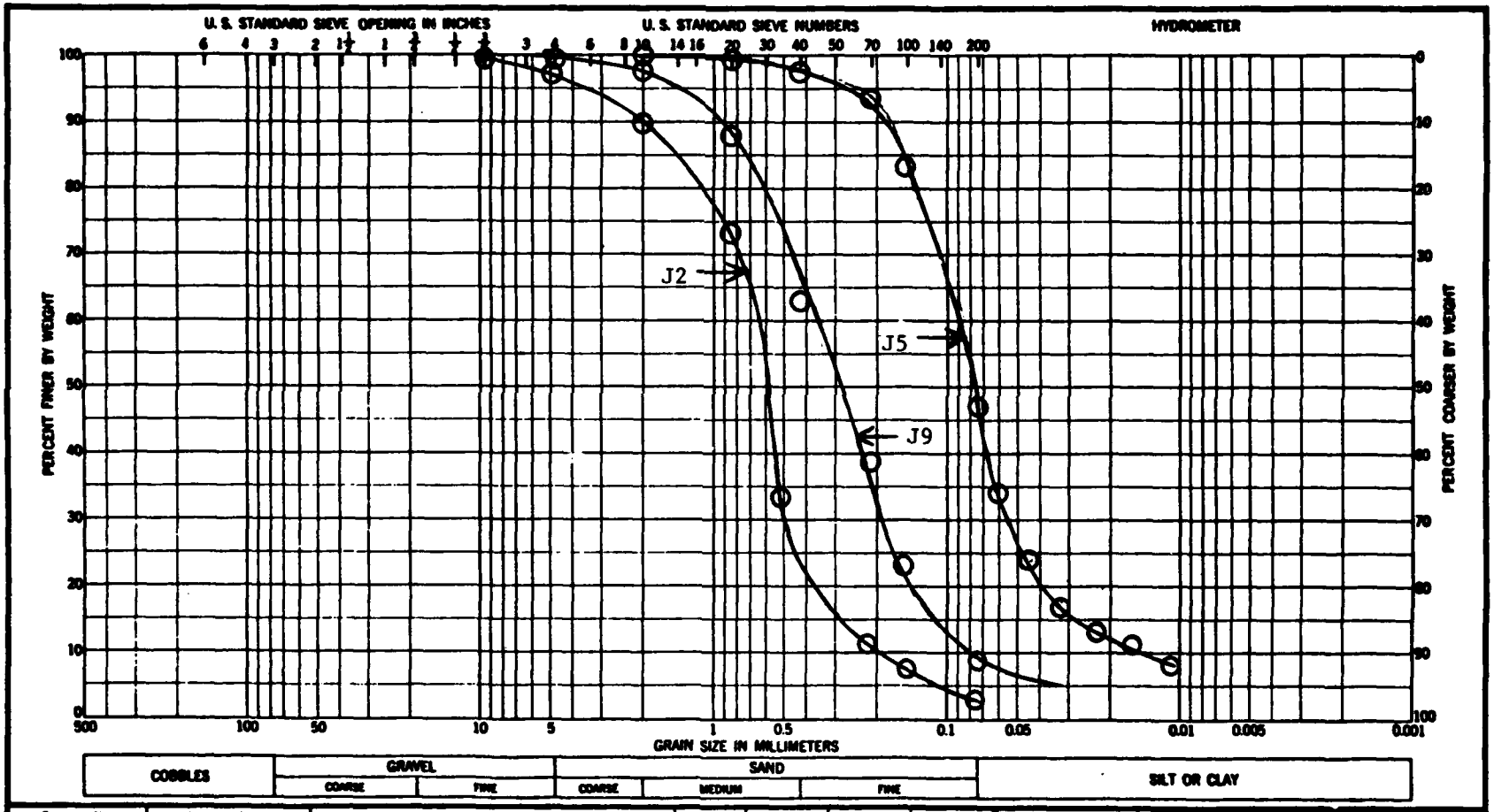


GRAPHIC SCALES
1" = 200'-0"
200' 0 200' 400'

WATER RESOURCES IMPROVEMENT STUDY
CAMP ELLIS HARBOR
SACO RIVER, SACO MAINE
ENVIRONMENTAL SAMPLING

FIGURE 10

SIEVE - GRAIN SIZE ANALYSIS



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
J2	3.0-5.0'	SAND (SP)				
J5	10.0-14.0'	SILTY SAND (SM)				
J9	17.0-20.0'	SILTY SAND (SP-SM)				

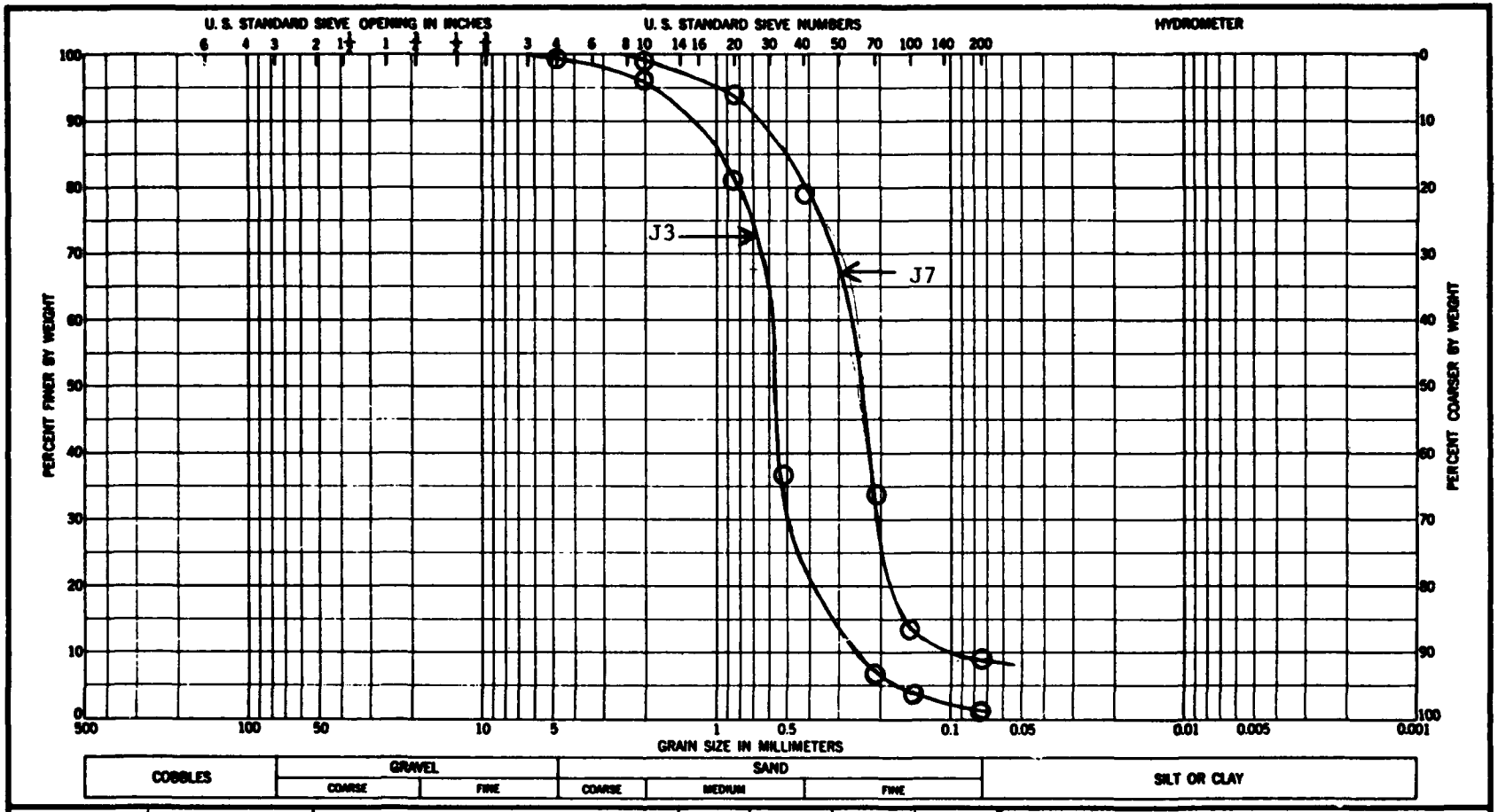
GRADATION CURVES

Project CAMP ELLIS HARBOR
SACO RIVER, SACO, MAINE
Area
Boring No. FD-8
Date OCTOBER 1979

ENG FORM 1 MAY 63 2087

FIGURE 11

SIEVE - GRAIN SIZE ANALYSIS



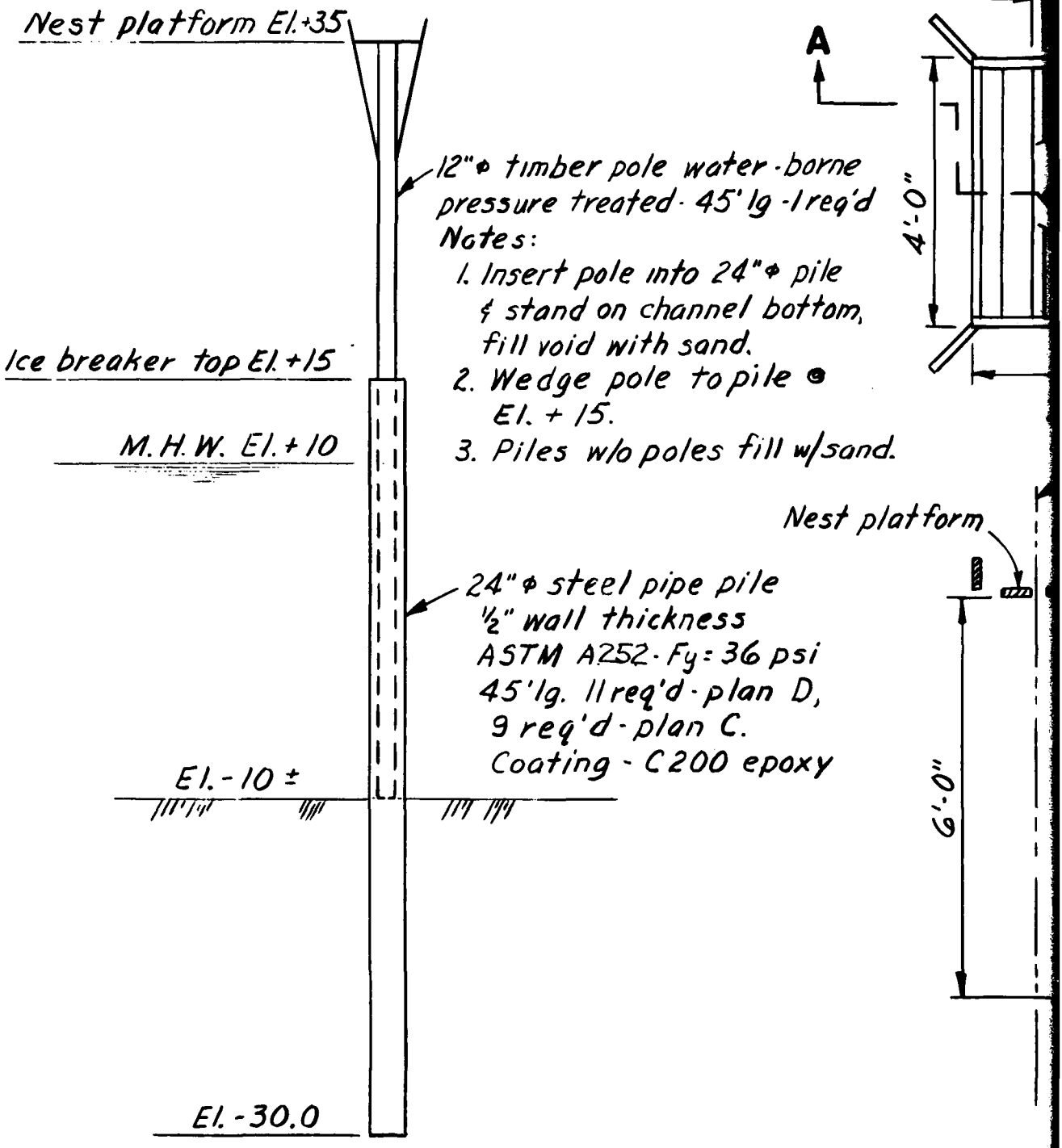
Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
J3	5.0-10'	SAND (SP)				
J7	15.0-20.0'	SILTY SAND (SP-SM)				

GRADATION CURVES

Project: CAMP ELLIS HARBOR
SACO RIVER, SACO, MAINE
Area:
Boring No.: FD-9
Date: OCTOBER 1979

ENG FORM 1 MAY 63 2087

FIGURE 12



ELEVATION

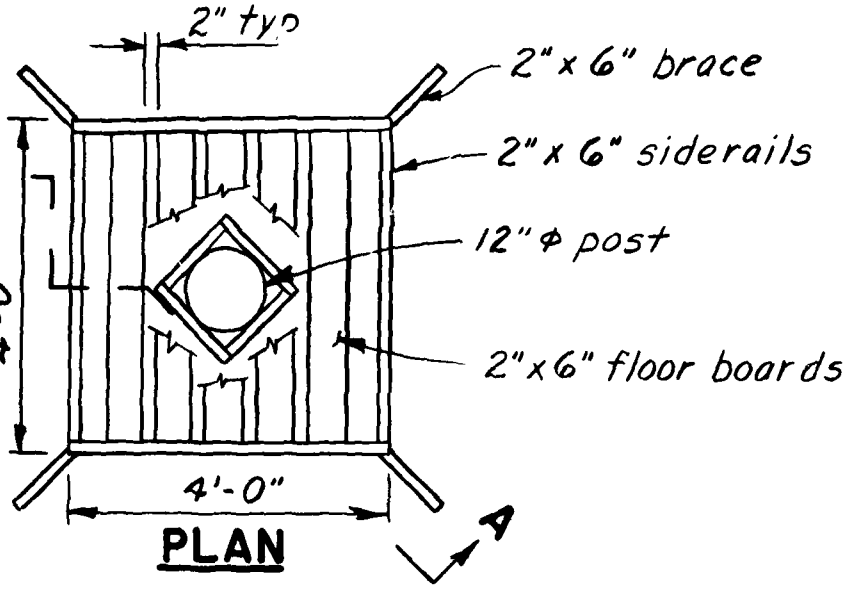
(BREAKER AND PLATFORM)

SCALE: 1/8"=1'-0"

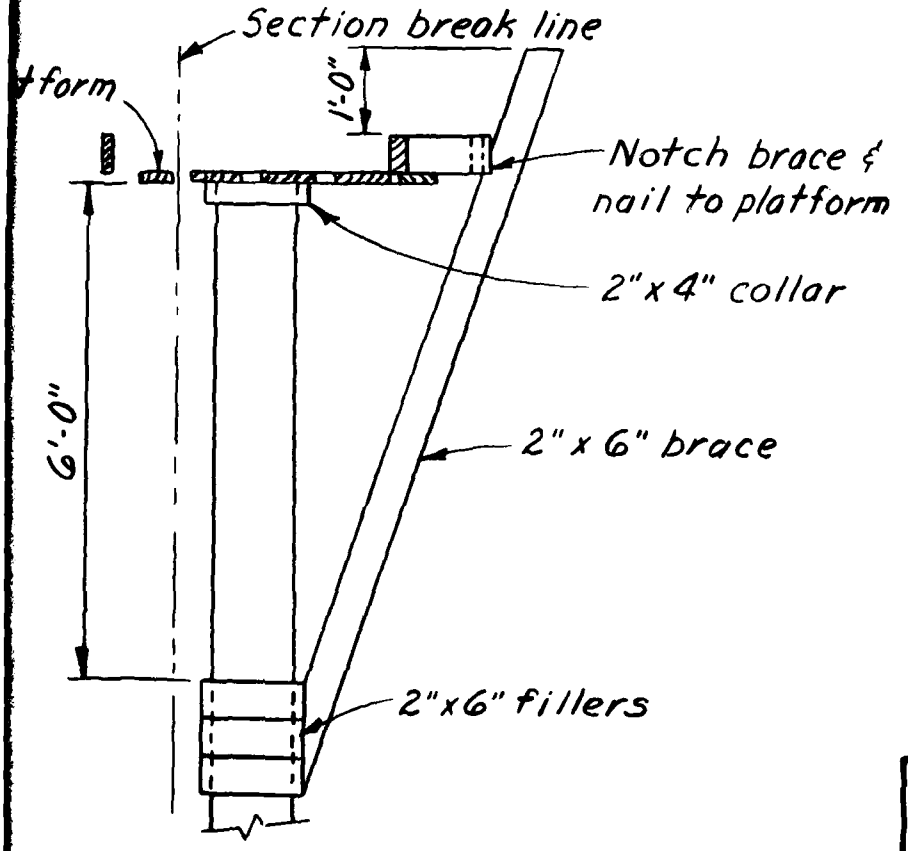
SEC

(OSPREY

SCAL



PLAN



SECTION A-A

(SPREY NEST PLATFORM)

SCALE: 1/2"=1'-0"

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

SACO RIVER, CAMP ELLIS HARBOR

ICE BREAKER AND OSPREY NEST PLATFORM

SACO, MAINE

DATE: FEB. 1981

FIGURE 13

CAMP ELLIS HARBOR
SACO RIVER
SACO, MAINE

DETAILED PROJECT REPORT

PROBLEM IDENTIFICATION

APPENDIX 1

PREPARED BY
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

LIST OF TABLES

TITLE

LIST OF FIGURES

TITLE

PROBLEM IDENTIFICATION

SECTION A

ANALYSIS OF EXISTING TRENDS AND CONDITIONS

This appendix contains information supplementing the first two sections of the MAIN REPORT, INTRODUCTION and PROBLEM IDENTIFICATION.

PRIOR STUDIES AND REPORTS

Federal interest in the Saco River dates back to 1824 when the removal of obstructions at the entrance to the river was undertaken along with construction of piers and aids to navigation. Jetty construction began with the North Breakwater which was originally authorized by the River and Harbor Act of 23 June 1866. Several studies, reports, and reviews have been conducted since then in an effort to develop the river's economic potential and protect shorefront properties. While many reports have been published concerning beach erosion and sediment transport relative to the Federal jetties and beach restoration projects this report will not address or refer to these since its emphasis is on small navigation improvements. A list of documents related to navigation improvements and a brief description of each is provided in Table 1-1.

In June 1976, at the request of local officials in the city of Saco, the New England Division of the U.S. Army Corps of Engineers prepared a Small Boat Navigation project Reconnaissance Report to determine the need for further detailed study of navigation improvements in Camp Ellis Harbor. The reconnaissance report set forth a conceptual plan for protection of the existing 6-foot mlw north anchorage and the city pier. The reconnaissance report indicated that the project would have a positive benefit/cost ratio and recommended that further detailed study be undertaken.

LOCATION

Camp Ellis Harbor is located in the southeastern part of the city of Saco, York County, Maine. It is about 15 miles southwest of Portland, Maine and 35 miles northeast of Kittery, Maine. The harbor is located on the northern side of the Saco River at its terminus at the Atlantic Ocean at Saco Bay. See Figure 1-1 for the location of the study area. Access to the village of Camp Ellis is provided by Maine Route 9.

The specific geographic area that this study addresses includes the immediate harbor area and the city of Saco. Anticipated impacts will also be generally discussed in the context of their economic effects on York County and the State of Maine.

TABLE 1-1

SUMMARY OF PRIOR STUDIES AND REPORTS

NATURE OF REPORT	WORK CONSIDERED AND RECOMMENDATION	PUBLISHED IN
Preliminary Examination 7 October 1882	Repair and extend breakwater 2200 feet to Sharp's Ledge. A stone jetty on south side of channel. Dredging bar between jetties to 5 feet mlw. Favorable - survey authorized.	S. Doc. No. 44 48th Cong., 1st Session
Survey 3 August 1883	Restoration and modification of breakwater by 2200 feet to Sharp's Ledge. A 3000-foot stone jetty on the south side of channel. Dredging to 5 feet mlw between the jetties. Favorable.	Not published
Preliminary Investigation 1 September 1884	Construct a 6-foot mlw channel from the ocean approximately 5.5 miles upstream to Saco. Survey Authorized.	H. Doc. No. 37, 49th Cong., 1st Session 1886
Survey 16 October 1885	Construct a 6 foot mlw channel from the ocean approx. 5.5 miles upstream to Saco. Favorable.	H. Doc. No. 37 49th Cong. 1st Session 1886
Preliminary Examination 30 April 1909	Deepen the existing channel to 7 feet mlw from the sea to the head of navigation. Favorable - survey authorized.	H. Doc. No. 752 61st Cong. 2nd Session
Survey 12 February 1910	Deepen the existing channel to 7 feet mlw to the head of navigation at Saco. Extend South Jetty 500 feet to deep water. Extend North Jetty to Sharp's Ledge.	H. Doc. No. 752, 61st Cong., 2nd Session.
Preliminary Examination 15 December 1922	Deepening of the existing 7-foot channel. Unfavorable.	H.Doc. No. 477 68th Cont. 2nd Session
Survey 31 March 1924	Deepening of the existing channel to 8 feet mlw from the head of navigation to the sea. Extend north jetty 1600 feet and extend south jetty 200 feet. Favorable.	H. Doc. No. 477, 68th Cong., 2nd Session

Survey 3 July 1929	Proposed measures of power development, flood control and irrigation assistance. Unfavorable. No navigation improvements deemed necessary.	H. Doc. No. 659 71st Cong., 3rd Session
Survey 11 July 1934	Extension of the north breakwater/ jetty to Sharp's Ledge. Favorable.	H. Doc. No. 11, 74th Cong. 1st Session
Detailed Project Report-September 1967 Survey	Recommended two 6-foot mlw anchorages at Camp Ellis totaling 10-1/2 acres, and a 10-acre, 6-foot mlw maneuvering basin at the head of navigation. Favorable - authorized 14 November.	

EXISTING CONDITIONS

GENERAL CONDITIONS OF THE STUDY AREA

Geographically Camp Ellis Harbor is located at the seaward end of the Saco River estuary. The village itself is situated on the landward side of a migrating spit with the seaward side being Camp Ellis Beach. The Saco River is the site of an existing Federal navigation project as shown in figure 1-2. A breakwater extends from Camp Ellis on the north side of the river mouth 6600 feet east to Sharp's Ledge. It protects vessels passing the river mouth from northerly and easterly wind and waves off Saco Bay. A stone jetty extends from Hills Beach in Biddeford on the south side of the river mouth 4800 feet east to deep water. This jetty constricts the river mouth cross section forcing the river to scour a deeper channel thereby limiting the frequency of channel maintenance operations. Saco Bay itself lies between the headlands of Prouts Neck to the northeast and Fletchers' Neck to the south.

Geologically the Saco area is characterized by glacial deposits overlying a complex association of igneous and metamorphic rocks which have been heavily deformed and further altered by mesozoic and paleozoic intrusives.

The bedrock of the southern Maine region consists of a series of rather weak gneisses, schists, and quartzites that are intruded by bodies of granite and basic igneous rocks of varying composition. Over this region, the last ice sheet had a movement of south, 29 degrees east. Rock outcroppings form small islands and shoals throughout Saco Bay.

The bedrock of the Saco area is frequently exposed at the surface. The Saco River geology is made up of stratified rocks of the Silurian Merrimack group. Large areas along the river are composed of a veneer of glacio-marine blue clays covered by sandy stratified drift. The area has been heavily influenced by glacial activities.

The shoreline at Saco is one of submergence of the land with respect to sea level. The entire area is within the glacial wash plain of the Saco River Basin. Material picked up and transported by the glaciers and deposited when they retreated from the area cover at least 90 percent of the present surface of the State of Maine. Drift may be stratified or unstratified. The unstratified drift, or till, is characterized by lack of structure and is formed by the work of ice alone. The stratified drift, or wash, is formed of glaciated material more or less reworked by waters. It appears that the beaches in Saco Bay may have been formed as spits that grew in both directions from the high ground at Old Orchard Beach.

Climatologically the Saco River valley is subjected to two major influences, namely the White Mountains to the west and the Atlantic Ocean to the east, according to data compiled by the National Oceanographic and

Atmospheric Administration. Mean temperatures for January and July 1976 were 19.5°F and 70°F, respectively. Precipitation is fairly well distributed throughout the year with 1976 mean precipitation (Saco) of 45.14 inches. The freeze free period at Saco was 181 days. Climatological data (30-year means) are not available for Saco-Biddeford, so Portland data will be presented for the area's mean windspeed (8.8 mph) and prevailing direction (westerly).

Hydrologically the Saco River estuary, from the river mouth to the tidewater dam in Biddeford-Saco, is a 6-mile bedrock channel with highly irregular bottom topography. The circulation pattern within the estuary is controlled by freshwater flows in the Saco River and by tidal currents. On each floodtide, a saltwater wedge moves approximately 4 miles upstream pooling the freshwater discharge until the end of flood when the ebb current carries the lighter freshwater over the salt wedge toward the ocean. This estuary may be classified as a horizontal to inclined salt wedge estuary, which exhibits a highly stratified salt gradient with salinity ranging from 0 to 30 parts per thousand (ppt). Deep pockets within the bedrock channel have been observed to collect the higher saline water from a floodtide and retain this saltwater through an entire tidal cycle until it is mixed with the saltwater of the next flood.

The mean flow in the Saco River as measured by the United States Geological Survey (USGS) at Cornish, Maine in 1976 was 3,337 cubic feet per second (cfs). The maximum flow was 18,900 cfs, and the minimum flow was 765 cfs.

The tides at Saco are semidiurnal. At Old Orchard Beach, adjacent to Saco, the mean range is 8.8 feet and the spring range is 10.1 feet. At Portland the mean and spring ranges are 9.0 and 10.4 feet, respectively. A study of tides recorded at Portland, 16 miles north of Saco, shows that on an average tides exceed the plane of mean high water approximately as follows: by 1 foot or more 116 times a year; by 2 feet or more 19 times a year; by 3 feet or more once each year.

The extreme low tide recorded at Biddeford Pool, approximately 1.7 miles southeast of Camp Ellis is 3.5 feet below mean low water (mlw).

Currents at Camp Ellis Harbor are predominantly influenced by the rivers' flow and by the tide.

As a result of the large tidal range and the narrowness of the Saco River estuary, strong tidal currents exist in the estuary. During floodtide the deeper currents are stronger than the surface currents. During ebbtide the surface currents are stronger than the deeper currents. Ebb current velocities have been observed to be greater than 3.0 knots on the surface with a turbulent mixing layer along the salt wedge. Maximum flood velocities of 2.5 knots were measured near the mouth of the river and in the vicinity of the deeper pockets in the channel bottom. From March to May heavy freshwater discharges to the estuary from the Saco

River can increase the channel depths by as much as 8 feet above high water at Saco. This condition also causes dangerous currents, i.e., greater than 3.0 knots during ebbtide. Currents and their effect on ice flow are discussed in detail in Appendix 4.

Because of its protected nature the lower estuary and Camp Ellis Harbor are not significantly affected by wind and waves. The breakwater and jetty effectively stop waves entering the estuary from Saco Bay. The narrow and restricted nature of the estuary itself provides only a very short fetch over which winds may generate waves. The prevailing winds are westerly with easterly winds occurring about 24 percent of the time.

The most intense storms affecting Saco are hurricanes which originate in the West Indies, move westerly of their usual track toward New England, and pass over or near the coast causing exceptionally high storm tides and severe wave action. However, due to their much greater frequency and longer duration, easterly gales and high winds are of greater concern. Easterly gales create a tidal surge along the Maine coast larger than that caused by tropical storms.

POPULATION

The city of Saco, located on the northern bank of the river, has experienced moderate population growth since 1960. In that year, the U.S. Census listed 10,515 residents, compared with 11,678 in 1970, an increase of approximately 11.0 percent in that decade. This growth greatly exceeds the corresponding increase for the State of Maine of 2.5 percent and is only slightly less than that of New England as a whole, 12.7 percent. The U.S. Census preliminary estimate of the 1980 population of Saco is 12,933, reflecting an increase over the most recent decade of 9.7 percent. This would indicate that the rate of population growth in Saco has decreased slightly, while the State of Maine grew much more rapidly for a total increase of 11.6 percent between 1970 and 1980. Future population projections predict a continuation of this moderate growth trend in Saco.

HOUSING

There is minimal development along the Saco side of the river as a result of topography and the marsh areas located there. However, new residential growth is occurring. New growth is also evident in the Camp Ellis area. The U.S. Census preliminary estimate for 1980 places the number of residential housing units in the city of Saco at 5,190. This represents an increase of 26.7 percent over the 1970 level of 4,095.

As a result of growth in second homes and the area's increasing popularity, Hills Beach, Fort Hill, Biddeford Pool, and Fortunes Rock have evolved into higher income enclaves. This change to higher income housing is also evident in Camp Ellis. Camp Ellis is the site of many older vacation homes.

ECONOMIC CHARACTERISTICS

The relative economic condition of this area is difficult to assess because no extensive economic data is compiled in Saco on a regular basis. U.S. Department of Commerce estimates for per capita income in the city were $2,619 in 1969 and $3,765 in 1974, an increase of 43.8 percent. These income level values compare favorably with those for the State in absolute dollar terms, $2,548 in 1969 and $3,694 in 1974, even though the rate of increase over that 5 year period for the State as a whole was slightly greater, 45.0 percent. In terms of real dollars, it is questionable whether the standard of living increased at all since the overall rate of inflation for that five period totaled approximately 47.0 percent.

Another indicator of relative economic well-being in Saco is the number of residents living below the poverty level of income. Little change has occurred in this area over the 5 year period 1970-1975, during which the measure rose from 1,393 persons (12 percent of the population) to 1,414 persons (11 percent of the population). The State of Maine's average population living below the poverty level of income is approximately 8 percent.

Thus, while per capita income in Saco averages slightly higher than the State as a whole, the percentage of its population living in conditions of poverty is significantly greater than that of the State. This would suggest that there are significant numbers at each extreme end of the income ladder, many very poor and many above average.

Since the State of Maine does not publish employment by industry data at the town level on a regular basis, ascertaining an exact employment mix in Saco is difficult. Occupational categorization of the 4,619 members of the 1970 labor force is available through the U.S. Census, however. In that year, the number of employed residents totalled 4,498 or 97.3 of the labor force resulting in an overall unemployment rate of only 2.7 percent. Estimation of monthly unemployment rates by city and town was initiated in Maine in March 1978 and has averaged 4.26 percent in Saco for the first five months for which an estimate has been published, considerably lower than the National, State, or Portland SMSA's unemployment rate. Because Maine and the coastal area in particular are summer vacation attractions, the unemployment rate peaks at approximately 6.0 percent during winter months and is significantly lower in summer.

The U.S. Census listed the major occupation in Saco in 1970 as operative (except transport), including 1,203 workers of which 1,103 were manufacturing industry operatives. Including an additional 91 managers and administrators in manufacturing industries, a total of 1,194 or 25.8 percent of the labor force, derive their income from the manufacturing sector. Manufacturing, therefore, provides the economic base for the community.

Other major occupational groups in Saco are craftsmen, including mechanics and metal workers (15.6 percent); clerical workers (14.3 percent); and those additional categories shown in Table 1-2. Although the labor force has grown slightly since 1970, local officials believe little change has occurred in relative proportions of each occupational category.

TABLE 1-2

EMPLOYMENT BY OCCUPATION IN SACO
1970

Occupation	Number	Percent of Labor Force
Operatives except transport	1,203	26.0
Manufacturing	1,103	23.9
Non-manufacturing	100	2.2
Craftsmen, Foremen, and Kindred	721	15.6
Construction Craftsmen	174	3.8
Metal Craftsmen	128	2.8
Repairmen and Mechanics	112	2.4
Other Craftsmen	307	6.6
Clerical and Kindred	660	14.3
Professional, Technical, & Kindred	452	9.8
Managers & Administrators, non-farm	438	9.4
Manufacturing	91	2.0
Retail Trade	178	3.9
Other Industries	169	3.7
Service Workers	368	8.0
Sales (Wholesale & Retail)	250	5.4
Laborers (except farm)	212	4.6
Freight, Stock & Material Handlers	107	2.3
Construction	15	.3
Other Laborers	90	2.0
Transport Equipment Operatives	133	2.9
Farmers, Farm laborers, foremen, managers	32	.7
Household workers	29	.6
TOTAL	4,498	97.3

Source: Compiled with U.S. Census data

It is also known that approximately 75 percent of all members of the Saco labor force are employed within York County, in which the city is located, and that the vast majority find employment in their home city.

Camp Ellis Harbor enjoys many natural locational benefits, with easy access to the open sea and a proximity to the finest and most frequently used lobster beds off the Maine coast. Local fishermen choose the harbor as their preferred anchorage site, despite the expected problems encountered in the winter season, because the travel distance to these prime fishing grounds is shorter than from any of the alternative anchorages. This is a particularly important asset during the winter months when seas are characteristically rougher and the air temperature generally well below freezing. The breakwater and jetty have provided adequate wave protection in the Saco River and continued maintenance dredging of the channel has allowed problem-free access regardless of tidal conditions. This latter advantage is one not shared by the nearest alternative anchorage at Biddeford Pool, where entrance channel is almost unnavigable at low tide. Camp Ellis is also convenient to major regional wholesale distributors, which in turn find a ready market in local residents, tourists, restaurants, and retail stores all over the northeastern United States.

Much of the seasonal employment and income in Saco is associated with recreational and commercial activities at Camp Ellis Harbor. The primary fishery resource for Saco fishermen is lobstering during the majority of the year with finfishing becoming the major commercial activity from December to March when lobsters migrate to deeper waters and become very difficult to trap. The peak lobstering season occurs in late summer and early fall, during the months of August, September and October, and the low point during winter and early spring, January through April. The fishermen cite the migratory habits of the lobsters as the major reason for the seasonal nature of the industry, as the lobsters move to deeper water during the winter months. Severe weather conditions generally render the extra travel time involved in reaching the lobsters and the additional problem of trapping them at a greater depth unacceptable to most lobstermen. The estimated gross haul of lobsters in 1977 was $500,000 with finfish, primarily haddock, cod, and pollock, generating approximately $150,000 during the same period. In 1980, the estimated gross haul of lobster was $750,000 and estimated finfish catch was valued at $375,000.

Because of the difficulties encountered in lobstering during the cold winter months, the major commercial activity at Camp Ellis Harbor from December to March becomes finfishing, which does not require as great a travel distance. It is estimated that at least half of the annual finfish catch of approximately $375,000 occurs during the four month period. The gross haul of fish at Camp Ellis Harbor does not approach its potential total, however, because inadequate facilities in the harbor force most fishermen to haul their vessels ashore and remain idle, or relocate to Pine Point, or Portland. The near-termination of commercial activity at Camp Ellis during the winter is the result of extensive damage to vessels from large sheets of ice which form in the predominantly fresh water upstream, break away, and follow the current downstream into the anchorage site. Many of these ice floes weigh up to 40 tons and have been observed

traveling through the anchorage in excess of 100 feet per minute, cutting deep into wooden vessels upon collision. During the winter of 1976-1977, only three vessels remained active in Camp Ellis Harbor, all of which suffered major structural damage. The following winter, 1977-1978, eight vessels remained active, one of which sank (resulting in an estimated loss to the owner of $2,500) and seven of which required an average of $250 in repairs in excess of the normal annual maintenance costs. The harbormaster maintains that six vessels are expected to remain active during a typcial winter season, and that few, if any, escape structural damage.

LAND USE

The predominant land use along the Saco River from Saco-Biddeford to the sea is residential. Virtually all industrial land uses in both cities are located on either side of and on Factory Island. Other industrial areas are located in existing industrial parks in Biddeford (Alfred Road Park, Biddeford Industrial Park, Biddeford Airport Industrial Park, and the proposed Airport Industrial District) and in Saco (Saco Industrial Park). Commercial land uses are centered in the downtown district of both cities, although there is considerable commercial strip development along U.S. Route 1 and to a lesser extent, Maine Route 9.

Existing land use plans show that no radical changes to existing land use should occur. Almost all ocean frontage in Maine is under development pressure for both frist and second homes. The residential nature of the Saco River, until one reaches the centers of Saco and Biddeford should also remain unchanged.

Recreational lands are an important land use along the Saco River. A number of marine facilities are located on the river and many homes have boat docks. The major park facilities in Saco include Diamond Riverside Park, Pepperell Park, Camp Ellis Beach, Bay View Beach and Kinney Shores Beach. Ferry Beach in Saco is a 111 acre undeveloped State park area. Thunder Island is a large stretch of undeveloped land which is currently protected under the Maine open space tax plan.

Marine Facilities

The Saco River (from Saco-Biddeford to the sea) serves as a harbor for fishing vessels, yachts, and small pleasure craft. Boating activities are centered around fishing and recreational uses. Both fishing and recreational boating compete for space at Camp Ellis.

There are no active commercial wharves at Saco or Biddeford. There are four major marine facilities located on the Saco River in addition to the public pier at Camp Ellis Harbor. The locations of these facilities are shown on Figure 1-3. A list of these facilities and the services they provide is given below.

1. Riverside Anchorage, Glenhaven Circle, Saco is a marina operation consisting of 110 slips. The marina has space to accommodate transients. Fuel and marine supplies are also available.

2. The Saco Yacht Club, Front Street, Saco, is the major private yacht facility on the Saco River. The Yacht Club has approximately 70 slips and 170 members. There are no immediate plans for expansion, although the facility is operating at capacity.

3. Rumery's Boatyard, Inc., 109 Cleaves Street, Biddeford, Maine is a combination marina-boat repair facility. Rumery's has 42 slips for rent. There is a mobilelift (12 ton, 40 feet, available on the premises. Inside storage is available for 50 boats and 24 boats outside. The boatyard custom builds vessels, repairs hulls and inboards, and sells marine supplies.

4. Meeting House Eddy is a 10 acre state administered boat access site located on the Saco River in Biddeford. This is the chief public boat launching site for the lower Saco River. The average daily use of the facility was 15 units on the weekends, and 17 units on the weekdays. Ninety percent of its use was generated from Maine residents.(4)

5. The public dock at Camp Ellis is one of the most important docking facilities on the river. This dock is extensively used by lobster boats and commercial fishermen. The facility is also used by larger recreational boats.

PRESENT NAVIGATION

The Fleet

Much of the seasonal economic activity in Saco is centered around Camp Ellis Harbor, which is the home of a locally-based fishing fleet which operates out of the harbor primarily from April to November, although a few craft do operate during the winter months on a limited basis. Most fishing craft are hauled out of the water during the winter months. Marine commerce now located at Camp Ellis includes lobstering, shellfishing, and finfishing. The public pier at Camp Ellis is one of the most important docking facilities on the river. This pier is used extensively by lobster boats and commercial fishermen. The facility is also used by larger recreational craft. Additionally, the public boat ramp is located on the western side of the pier.

There is little information available on the number of vessel trips on the Saco River from the head of navigation to the sea. However as of 1976 there were approximately 520 boats of all sizes with a total value of $362,830 registered in Saco. Many of these craft are daysailers and are used for recreational boating along the river, as that portion of the Saco between Camp Ellis and the head of navigation is extensively used by pleasure boaters. During the recreational boating season approximately 30

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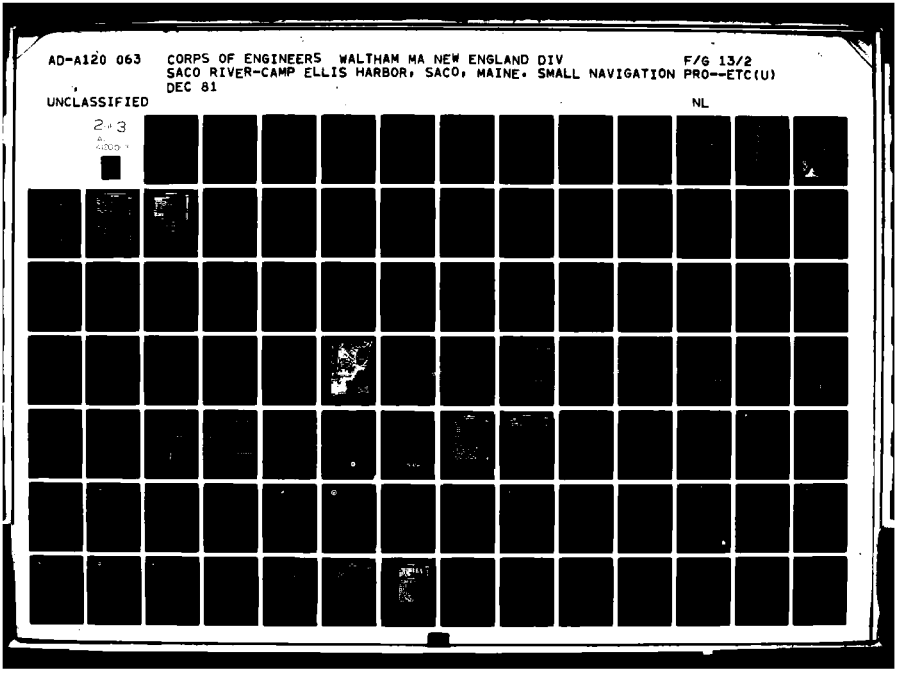


recreational vessels moor at Camp Ellis in addition to the 45 commercial vessels that work out of the Saco River.

The existing Federal project provides 10.5 acres of anchorage at Camp Ellis that currently accommodates approximately 75 craft. A public boat ramp is located on the western side of the city pier. There has been little change in the number of recreational craft using the harbor in recent years as it is usually filled to capacity during the recreational boating season.

During the peak summer and fall months, the 45 commercial vessels in the harbor provide approximately 75 full-time jobs and 15 part-time jobs. During a typical winter season, commercial fishing at Camp Ellis provides only about 18 full-time jobs. Many fishermen maintain a steady income flow by operating out of alternative ports, but many others find it financially disadvantageous to do so because of the additional costs involved in relocation.

Existing Federal Project

The existing Federal navigation project for the Saco River is shown in Figure 1-2. For the purpose of the following historic descriptions the project is presented in three sections, the River Channel and Anchorages, the North Breakwater/Jetty, and the South Jetty.

Federal provision of navigation improvements to the river channel began in 1824 with the removal of obstructions from the river mouth and construction of fender piers and aids to navigation (beacons and buoys). Dredging of the bar which periodically shoals across the river mouth at the end of the North Jetty was frequently accomplished to a depth of 5 feet mlw when jetty repairs or modifications were made. The River and Harbor Act of 1886 authorized a channel 6 feet deep mlw from the sea to the head of navigation at Saco/Biddeford. Construction of the 6-foot channel was completed in 1873. A 1910 modification increased the channel depth to 7 feet. The improvement dredging was completed in 1914. Deepening of the channel to its present 8 feet mlw was authorized by the River and Harbor Act of 3 March 1925 and completed in 1930.

The three 6-foot mlw anchorage areas totalling 10.5 acres at Camp Ellis and 10 acres at the head of navigation were authorized by the Chief of Engineers under Section 207 on 14 November 1967 and were completed in October 1969.

The North Breakwater/Jetty was originally authorized by the River and Harbor Act of 23 June 1866. Initial construction of the +8.9-foot mlw/3000-foot long rubble mound structure was completed in September 1868. Several modifications to increase the length and height of the structure have since been made and are as follows; 1871 - 1873 length increased by 1200 feet, 1897 - seaward end of structure heightened to +15 feet mlw, 1912 - add northward extending 400-foot long spur jetty to

control outflanking during storms, 1930 add 1600-foot long/+15.5-foot mlw extension, 1938 - add 830-foot long/+5.5-foot mlw extension to reach present length of 6630 feet, 1937 - raised inshore end of structure to +15 feet mlw, 1958 - repair damages to inshore end of structure, 1969 - raised inshore 850 feet of structure to +17 feet mlw and made sand tight to arrest channel shoaling.

The present North Jetty is 6630 feet long with elevations ranging from +17 feet mlw at the shoreward end to +5.5 feet mlw at the seaward end. Maintenance repairs were last completed in 1969 when the inshore end of the structure was raised and tightened to prevent sand passage through the structure which had accelerated shoaling in the entrance channel.

The South Jetty was first proposed in 1883 to restrict the channel to a limited cross sectional area in order to enable the river to scour a deeper natural channel. The jetty was authorized by the River and Harbor Act of 1890 and construction was begun the following year. The jetty was completed to a length of 4500 feet in 1894. The project was modified by the River and Harbor Act of 1910 and extended to 4800 feet by 1912. Maintenance of the jetty has since occurred in 1930, 1940, and 1971.

FUTURE CONDITIONS WITHOUT THE FEDERAL PROJECT

Several issues were considered in the development of the without Federal project condition or the "most probable future." Various scenarios of possible future conditions were considered based upon different economic climates and availability of funds from other than Federal sources. In all cases the continued maintenance of all portions of the existing Federal project is a given element.

ALTERNATIVE FUTURES

Scenario 1: This scenario reflects conditions to remain much as they are today. Without the implementation of improvements at Camp Ellis Harbor to provide ice protection to the vessels anchored there, local fishermen and the harbormaster expect that future winter activity at Camp Ellis will continue on a scale similar to that of past years. Damages to vessels will continue to occur at the same rate as now. Only a small percentage of the commercial fishing fleet would be expected to remain active from December through March; approximately 6 of 45 commercial vessels moored at the harbor during the summer would be expected to operate year-round, with the remainder being forced either to relocate to a nearby port or become inactive.

Scenario 2: This scenario suggests a reduced fleet. Smaller vessels would not continue to return a sufficient catch to justify their continued winter operations at Camp Ellis Harbor. An increased number of fishermen would abandon winter activities or relocate to nearby ports. Those fishermen choosing to invest in larger vessels to bring a greater return might also relocate, perhaps permanently, to other ports. The attendant

reduction in landings and income would possibly lead to a decline in the Camp Ellis community and a negative economic impact in the Saco area.

Scenario 3. All fishermen would either relocate or cease their winter operations. The rate of development of Camp Ellis into a summer residence community would increase. The harbor would be seasonally utilized by small recreational craft with a few seasonal commercial fishing operations.

Scenario 4. A combination of State, local and private interests would make some needed ice protection improvements in the harbor. This would permit increased and safer winter utilization of the harbor and city pier. A larger fleet would undertake commercial activities during the winter months to the benefit of Camp Ellis economy.

EVALUATION OF PROJECT ALTERNATIVE FUTURES

A continuation of the present conditions and level of activity as described in Scenario 1 does not appear likely. Some fishermen would not choose to continue operations under hazardous conditions and would relocate or cease winter activities. Winter and year-round landings would decrease leading to economic decline in the community.

It is unlikely that State, local, or private interests would provide the capital investment necessary to make improvements at Camp Ellis Harbor as stated in Scenario 4. The availability of such initial investment to the Camp Ellis or Saco community is unlikely given the present declining condition of the local economy. State funding has already been scheduled for improvement and rehabilitation of the public pier during FY 1982. Further State funding is not probable in the foreseeable future.

MOST PROBABLE FUTURE

The "most probable future" derived from these alternative futures is a combination of scenarios 1 and 2. The major component of this future condition of continued winter fishing operations would be a gradual decline in commercial activity over time as technology improves and fishermen who invest in newer and larger boats and equipment become reluctant to remain in a harbor that does not offer a safe, all weather anchorage.

The anticipated economic effects of a decline in commercial activity during winter months at Camp Ellis Harbor include: the loss of potential income and the additional expense of hauling boats ashore for those fishermen who are forced to become idle; the additional expenses involved in obtaining a new mooring, commuting to it, and traveling greater distances by sea to reach prime fishing grounds for those fishermen who are forced to relocate; and additional costs of maintenance, repair of damages, and possible replacement of vessels for those who choose to remain at Camp Ellis year-round.

As fishermen left the trade or relocate to other ports the nature of the Camp Ellis community would change with an ever increasing emphasis on seasonal residences. While a few commercial fishing operations would continue on a seasonal basis the fleet at Camp Ellis Harbor would become a largely seasonal fleet composed mainly of small recreational craft.

PROBLEMS, NEEDS AND OPPORTUNITIES WITH THE STUDY AREA

The problems, needs, and opportunities within the study area are directly related to commercial fishing activities during the winter season at Camp Ellis Harbor. Existing navigation facilities are inadequate to safely and economically accommodate the existing winter fleet. Improvements are needed to alleviate winter navigation difficulties and damages presently experienced by fishermen operating from Camp Ellis Harbor. An opportunity exists to improve the areas economy through providing benefits to the winter fishing fleet.

PROBLEMS

Although the problems may be summarized as increasing damages due to lack of adequate protection from ice floes passing through the harbor from upriver, several specific areas of difficulty may be identified.

Collisions between sheet ice floes and moored vessels cause considerable damage each winter. Chunk ice and shore ice collect and form in the existing anchorage area causing hull damage due to constant chaffing. Further the existence of large sheet ice floes in the anchorage makes navigation within, to, and from the anchorage hazardous.

These conditions force the majority of the 45 boat commercial fishing fleet to cease operations or relocate to other ports during winter months. The remaining active winter fleet is reduced to approximately 6 vessels with the majority of fishermen having pulled their boats out of the water and seeking other winter employment.

NEEDS

The needs of the community as developed through the identification of the problems are evident. A protected winter anchorage must be provided where vessels may moor and maneuver safely free from damages from all types of ice. This anchorage must be of a size sufficient to accommodate the present winter fleet and to attract several vessels, which are presently idle or have transferred to other ports, back to Camp Ellis Harbor during the winter season.

The public pier and dock must also be protected from sheet and chunk ice floes which can structurally damage the wooden dock. Protection from damages must also be provided to vessels tied up at the public dock in order to allow safe usage of this facility and reduce the present hazardous maneuvering conditions in the area of the end of the pier.

In light of the needs cited above the city of Saco has requested the following improvement for Camp Ellis Harbor.

An all weather anchorage to protect commercial fishing craft from ice damage.

OPPORTUNITIES

Improvements to facilitate winter navigation in Camp Ellis Harbor would provide for increases in the efficiency of the existing commercial fishing fleet during the winter months allowing for greater development of the available fisheries resources.

Reductions in ice related damages will lead to reduced costs and a reduction in lost fishing time. This along with encouraging more vessels to remain with the Camp Ellis fleet during the winter will increase landings and related income.

With this improvement, Camp Ellis Harbor faces a promising future in the commercial fishing industry, as it will become a more productive base of operations for commecial fishermen. Increased markets for New England lobster and finfish provide the opportunity for Camp Ellis Harbor to assume a more significant role in the regional economy if the desired protection against ice floes is provided.

The economic benefits resulting from the provisions of an ice free anchorage on the Saco River at Camp Ellis Harbor would accrue to the commercial fishing fleet. The ice-protected anchorage will immediately allow additional craft of the existing fleet to safely operate on a year round basis, a requirement for a viable and competitive commercial fishery. Within a few years the additional income earned by commercial fishermen operating year round should encourage them to modernize and upgrade their gear and equipment, and some may elect to purchase new boats.

Several environmental benefits would be realized with the construction of navigtion improvements in Camp Ellis Harbor. Placement of icebreaker structures would allow the opportunity to include a nesting platform for ospreys and anchorage dredging would provide material suitable for nourishing Camp Ellis Beach.

SECTION B

PROBLEM AND OPPORTUNITY STATEMENTS

NATIONAL OBJECTIVES

Planning for channel improvements in Camp Ellis Harbor is based in part on national objectives of economic development and enhancement of environmental quality. Section 103 of the Water Resources Planning Act of 1965 directed the National Water Resources Council to establish principals and standards for planning Federal and Federally-aided water resource projects. In 1980, the Council published Principles and Standards for Planning Water and Related Land Resources which provide the broad policy framework for planning activities. The Standards provide for uniformity and consistency in comparing, measuring and judging the beneficial and adverse effects of alternative water resource improvement projects. The purpose of the Principles and Standards is to promote the quality of life by planning for the attainment of the following objectives:

National Economic Development (NED)

- To enhance national development by increasing the value of the nation's output of goods and services and improving national economic efficiency.

Environmental Quality (EQ)

- To enhance the quality of the environment by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural resources, cultural resources and ecological systems.

These are termed National Economic Development (NED) and Environmental Quality (EQ) objectives. The NED and EQ objectives were fully considered in developing and evaluating the alternative improvement plans.

PLANNING CONSTRAINTS AND CONCERNS

Planning constraints are those items which can specify limitations that are used to direct plan formulation and restrict or minimize adverse impacts. Such impacts may affect a wide range of different concerns including natural conditions within the project site, technological states of the art, economic limits and legal restrictions.

This study has identified, through consultation with local interests, city, State, and Federal agencies and officials, and local fishermen, a number of concerns relative to Camp Ellis Harbor, the Saco River estuary and other aspects of the study area. Of these concerns three specify critical limitations on the planning process and therefore may be categorized as constraints.

PLANNING CONSTRAINTS

The following planning constraints were identified with respect to the proposal to provide Federal navigation improvements at Camp Ellis Harbor. These constraints place limitations on varying aspects of the planning process and the development of alternative plans of improvement.

The first constraint is to minimize adverse impacts on the fish and wildlife in the study area. Restricting construction activities to the fall and winter months will avoid turbidity in the water column during the spring-summer spawning run of alewives and the summer spawning time of soft-shell clams. Also, most waterfowl and shorebirds will nest in the spring and summer.

The second constraint involves possible engineering impacts on existing structures. Any jetty structure constructed must not restrict the width of the existing 8-foot Federal channel. Any dredging activities must not contribute to erosion and subsequent undermining of the existing dock, pier, or jetties. Any substantial increased rate of erosion at the shoreward end of the north Federal breakwater/jetty could lead to the eventual breakthrough of the sea behind the jetty due to outflanking during storms. An alignment which would place at a distance of at least 90 feet from any existing structure would be necessary in order to avoid any negative structural impacts.

The third and final constraint identified is to avoid any adverse impacts on the marine resources both within Camp Ellis Harbor and the surrounding waters. Any attempt to develop Camp Ellis Harbor in such a way or to such an extent as to allow the local fishing fleet and winter fleet to disrupt or deplete the existing marine resources would be detrimental to the long term utilization of the resource and of the harbor.

PLANNING CONCERNS

As stated above, consultations with local interests determined a number of concerns which should be identified and addressed.

The first identified concern deals with the rate of riverbank erosion along the Saco River. Any structural alternative should avoid measures that would accelerate the natural rates of erosion along the riverbanks in the Camp Ellis area. Any such erosion would have adverse impacts on riverfront properties and would necessitate more frequent maintenance dredging of the existing channel and anchorages.

A second concern involves the scheduling of construction activities so as to minimize the disruption of commercial fishing activities. Construction must also be coordinated with Camp Ellis residents so as to minimize the adverse effects of construction noise on the local inhabitants.

The economies of all the nearby harbors are predominantly based on the same source of income as Camp Ellis Harbor, i.e., commercial fishing operations. Surrounding communities must not be placed in a position of having to compete for the available fisheries and their livelihood. The enhancement of Camp Ellis's economy through expanded winter commercial fishing activities must not be at the expense of the economies of the other commercial fishing harbors in the area. Any improvements made at Camp Ellis Harbor must not be so extensive as to adversely impact on the economies of any other nearby fishing ports.

Conducting dredging activities during unfavorable weather conditions can be dangerous and costly. Operation of dredging and pile driving equipment must not be undertaken during adverse weather conditions. Disposal of dredged material during stormy weather can damage the environment in the vicinity of the disposal site due to inaccurate dumping and increased dispersion of the spoil due to waves and turbulence.

Dredging of any anchorage must minimize removal of any area of the intertidal zone. The intertidal zone is that area between mean low and mean high water which is an important source of food for commercially important species such as lobsters and finfish.

Disposal of any dredged material as beach nourishment which has been done with Saco River dredging in the past must take place in the winter months so as not to adversely impact on summer recreational activities and aesthetics at area beaches.

Construction activities within the estuary will lead to an increase in turbidity especially during any dredging operations. Water quality within the harbor will temporarily decline during dredging operations. Disposal at a nearby beach will allow the use of a hydraulic dredge pump instead of a clamshell dredge thereby minimizing the effect of dredging on turbidity levels and water quality.

PROBLEM AND OPPORTUNITY STATEMENTS

These statements are a means of defining a set of goals and study objectives which must be addressed to varying degrees by any considered plans of improvement. The problem and opportunity statements for this study were established after carefully analyzing the identified constraints and concerns regarding the use of water and related land resources in the study area. These statements are developed specifically for the given study area and will be utilized as a guide in the formation of alternative plans.

Based on the discussion of problems, needs, and opportunities, the following statements have been identified as important guidelines to formulation and and evaluation of plans to meet the area needs and study objectives.

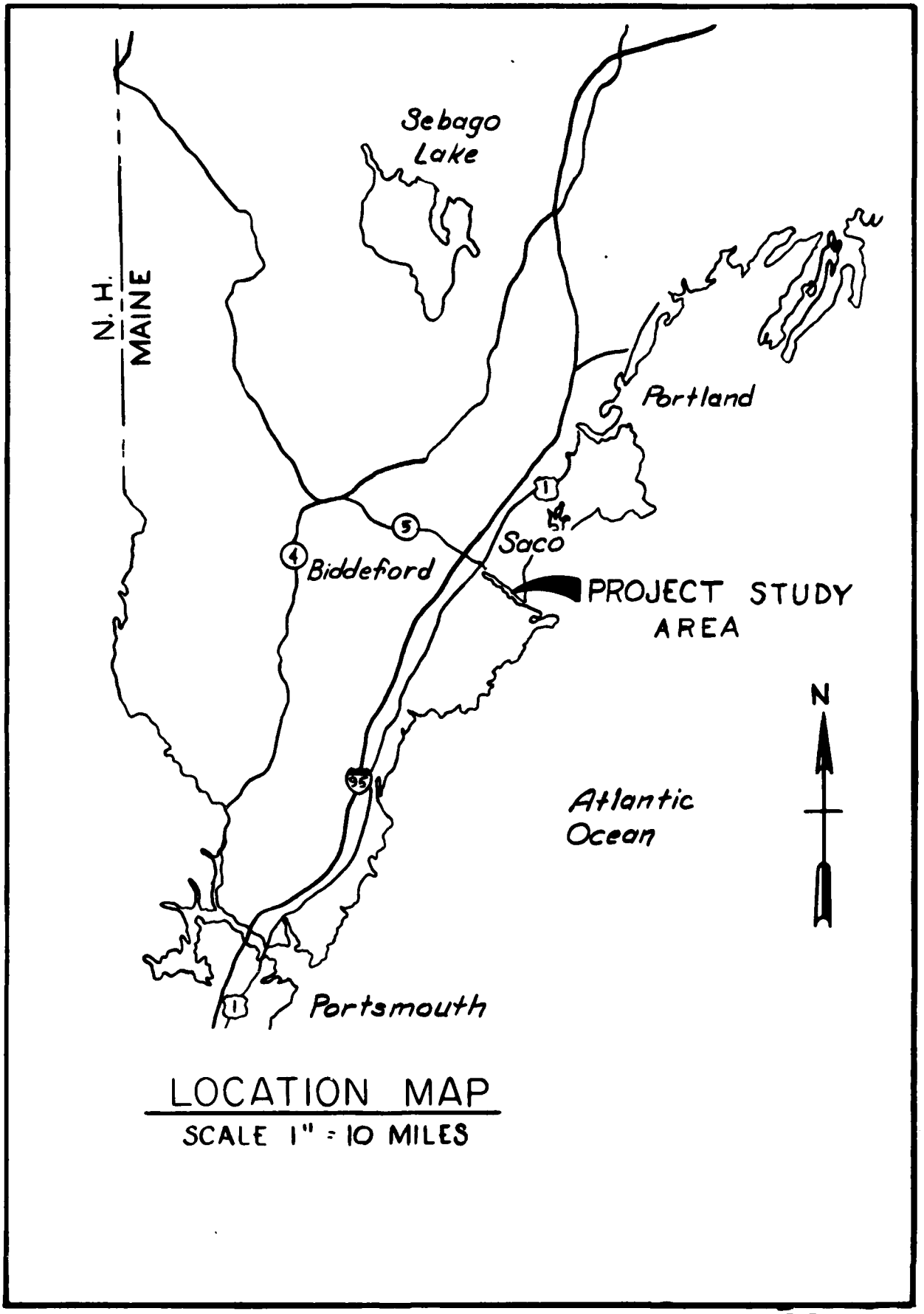
- Contribute to the safe mooring of commercial fishing vessels at Camp Ellis Harbor through a reduction of ice damage sustained by the fleet during the 1981-2031 period of analysis.

- Contribute to the preservation of adjacent beaches during the 1981-2031 period of analysis.

- Provide an increased degree of protection from ice damage to the wooden public dock at the Camp Ellis pier during the 1981-2031 period of analysis.

- Contribute to the increased utilization of Camp Ellis Harbor by local fishermen in the winter months during the 1981-2031 period of analysis.

Consideration of these statements and planning constraints led to the formulation of detailed alternative plans that will be presented in the following appendix.



LOCATION MAP

SCALE 1" = 10 MILES

FIGURE 1-1

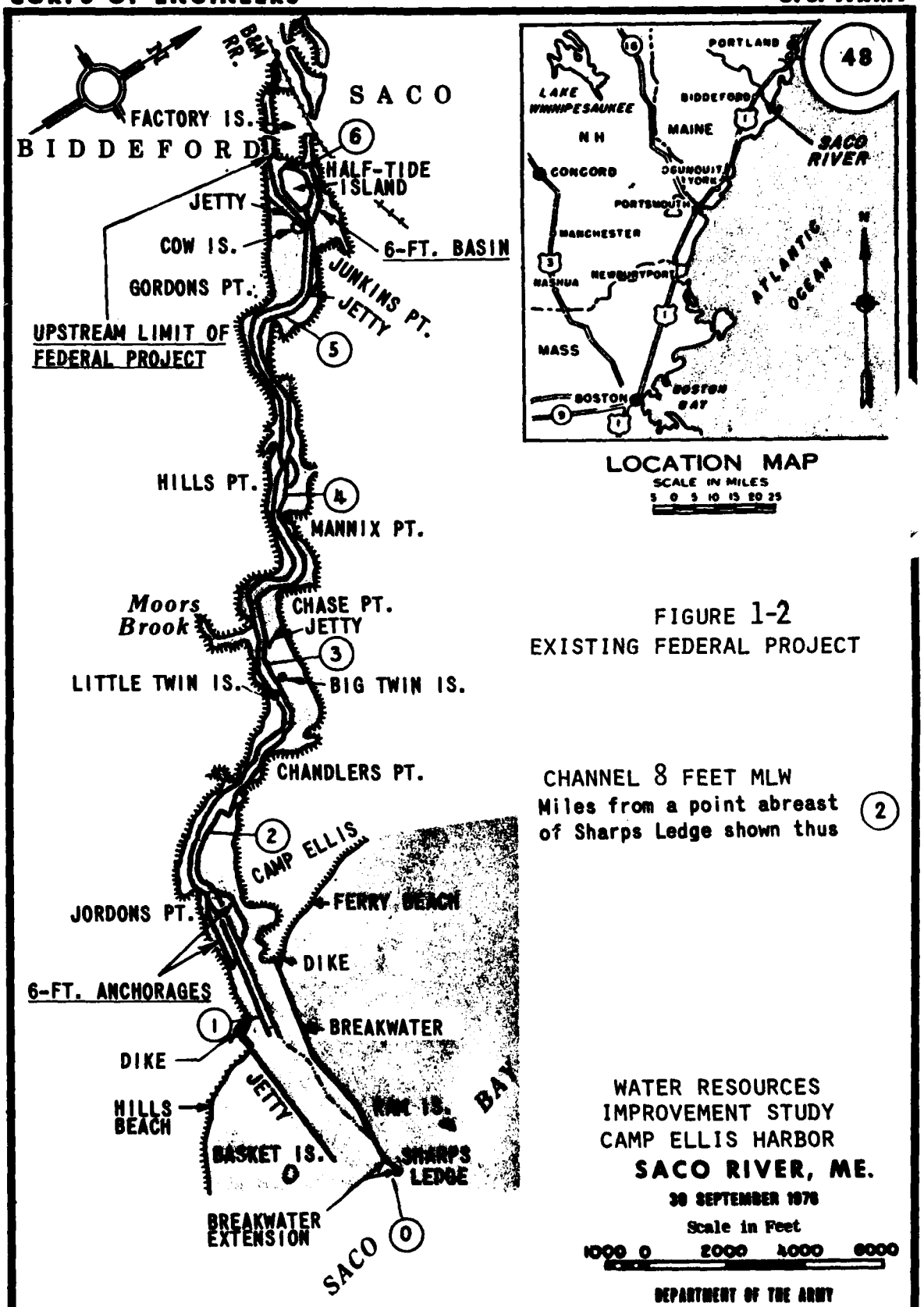


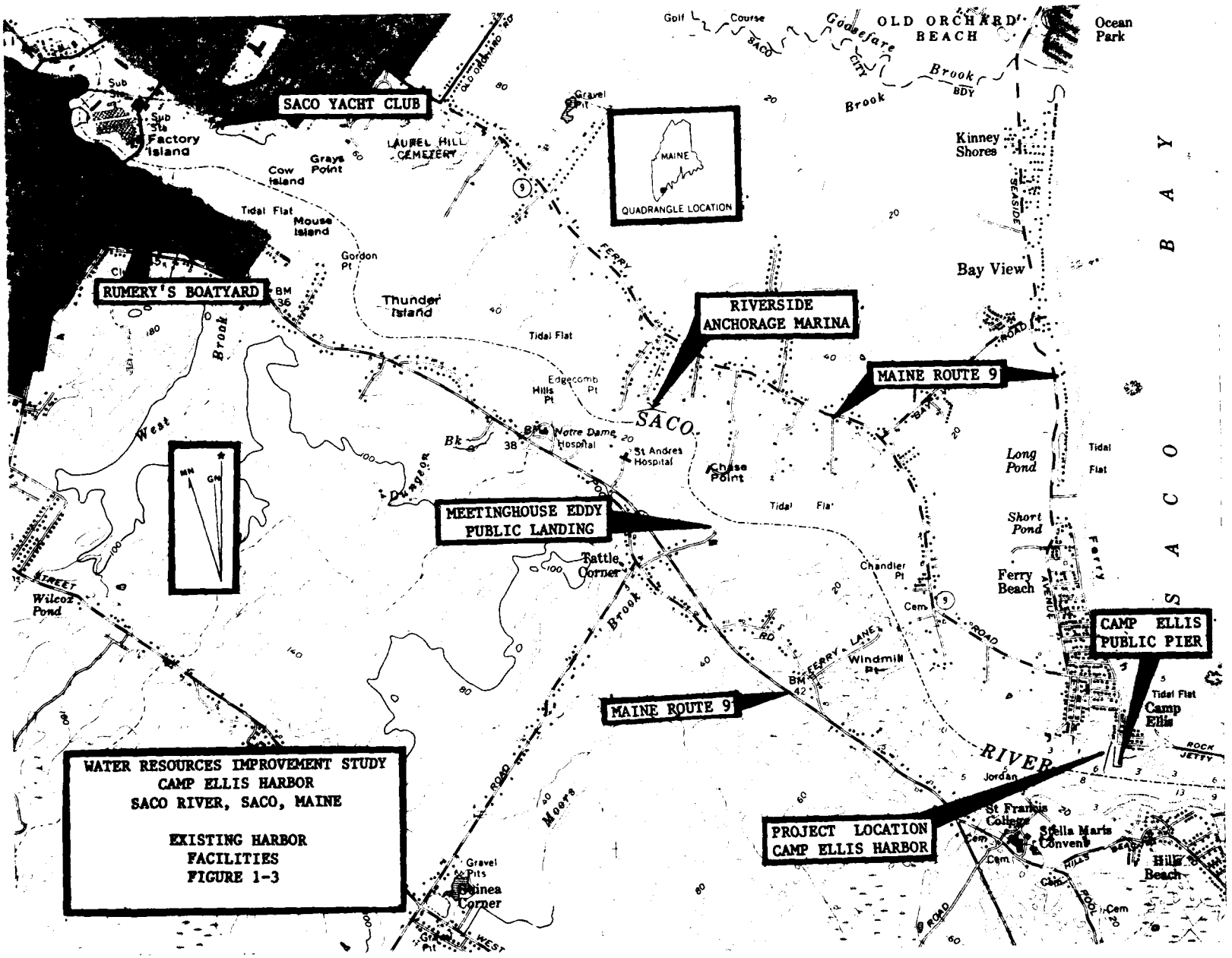
FIGURE 1-2
EXISTING FEDERAL PROJECT

CHANNEL 8 FEET MLW
Miles from a point abreast of Sharps Ledge shown thus (2)

WATER RESOURCES
IMPROVEMENT STUDY
CAMP ELLIS HARBOR
SACO RIVER, ME.
30 SEPTEMBER 1976
Scale in Feet
1000 0 2000 4000 6000

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

FIGURE 1-2


SACO YACHT CLUB
RUMERY'S BOATYARD
RIVERSIDE ANCHORAGE MARINA
MAINE ROUTE 9
MEETINGHOUSE EDDY PUBLIC LANDING
MAINE ROUTE 9
CAMP ELLIS PUBLIC PIER
PROJECT LOCATION CAMP ELLIS HARBOR
QUADRANGLE LOCATION
MAINE
SACO
OLD ORCHARD BEACH
Ocean Park
Kinney Shores
Bay View
Factory Island
Cow Island
Gray's Point
Mouse Island
Tidal Flat
Gordon Pt
Thunder Island
Edgecomb Pt
Hills Pt
Notre Dame Hospital
St Andres Hospital
Chase Point
Long Pond
Short Pond
Ferry Beach
Chandler Pt
Windmill Pt
Wilcox Pond
Tattle Corner
Gravel Pits
Guinea Corner
Jordan
St Francis College
Stella Maris Convent
Hills Beach
Camp Ellis
SACO BAY
RIVER
WATER RESOURCES IMPROVEMENT STUDY
CAMP ELLIS HARBOR
SACO RIVER, SACO, MAINE
EXISTING HARBOR FACILITIES
FIGURE 1-3

[redacted]
SACO RIVER
SACO, MAINE

DETAILED PROJECT REPORT

FORMULATION AND EVALUATION OF DETAILED PLANS

APPENDIX 2

PREPARED BY

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

LIST OF TABLES

LIST OF FIGURES

FORMULATION AND EVALUATION OF DETAILED PLANS

SECTION A

The formulation of a plan of improvement for the Saco River has followed the procedures of the Water Resources Council Principles and Standards. Local needs and objectives were identified and project-specific planning and opportunity statements were established. These planning and opportunity statements were considered in the formulation of detailed plans, as were the national objectives of National Economic Development (NED) and Environmental Quality (EQ).

FORMULATION AND EVALUATION CRITERIA

Detailed technical, economic and environmental criteria were applied in the formulation and evaluation of the alternative plans. These criteria reflect quantitative measures of the plan performance in relation to the national and local planning objectives and planning constraints. These criteria, which are described below, are utilized in the System of Accounts to evaluate the three alternative detailed plans.

TECHNICAL CRITERIA

The technical criteria are as follows:

- The selected plan should provide the maximum amount of safety from all types of ice to commercial fishing vessels operating out of Camp Ellis Harbor during winter months.

- The selected plan should provide for adequate safe anchorage area and depth to accommodate the numbers and types of craft expected to use the river during winter.

ECONOMIC CRITERIA

The economic criteria are as follows:

- Maximize net benefits (project benefits minus project costs).

- Maximize net benefits to the cities of Saco and Biddeford, and the commercial fishing fleet utilizing the Saco River.

ENVIRONMENTAL CRITERIA

The environmental criteria are as follows:

- Minimize volume of dredge material in order to reduce problems relating to disposal of dredged material.

- Minimize removal and alteration of intertidal areas and wetlands to avoid adverse environmental impacts.

SOCIAL AND CULTURAL CRITERIA

The social and cultural criteria are as follows:

- Maximize safety and ease of navigation for all craft utilizing the harbor.

- Maximize the cultural and aesthetic value to the harbor and any structures constructed.

- Contribute to the economic development of the Saco area.

SECTION B

FORMULATION OF ALTERNATIVE PLANS OF IMPROVEMENT

DEVELOPMENT OF MANAGEMENT MEASURES

As a basis for formulating alternative plans of improvement several management measures can be identified. These management measures take into consideration the problems, needs and opportunities of the study area as described in Appendix 1, and take into account one or more of the objectives set forth in the problem and opportunity statements. Management measures can be generally categorized as either structural or nonstructural in nature.

Structural measures would generally involve provisions for anchorages within the existing project limits or in the immediate area, which would provide mooring space for the commercial winter fleet safe from damage from all types of ice.

Structural management measures could include the following:

(1) Provide adequate protection from winter ice to the commercial fleet through the use of ice breakers surrounding the existing anchorage areas.

(2) Construct breakwaters capable of deflecting ice flow, thereby protecting the existing anchorages.

(3) Dredge new anchorages in areas of the river that are not currently subjected to significant ice flow problems.

(4) An economically feasible combination of the above measures.

Nonstructural management measures are those that achieve the stated planning objectives by means other than physical structural improvements within the study area. Nonstructural management measures could include the following:

(1) Transfer of winter commercial activities to another nearby port, or ports which are not subject to ice flow problems and could safely and efficiently accommodate an increased winter fleet.

(2) Implementation of an intensive program to physically or chemically breakup and transport river ice so as to minimize damage to commercial fishing vessels.

NO IMPROVEMENT OPTION

There are several alternatives to providing Federal improvements to Camp Ellis Harbor and the Saco River. These include nonstructural

measures as well as the provision of improvements by others. Such alternatives address the same planning objectives as a Federal improvement would. Following is an evaluation of the feasibility of those options selected for further study on the basis of their meeting the planning objectives.

Continue Existing Conditions

Presently commercial vessels operating out of Camp Ellis Harbor are subjected to extremely hazardous conditions in the Federal anchorages. Sheet and chunk ice cause much damage to moored vessels and present a hazard to navigation in the channel. If the current level of commercial winter activity continues, ice related damages to fishing boats will not be abated and may cause fishermen to cease winter operations or move from Camp Ellis Harbor to more protected ports. City officials have indicated that the locally planned development of the town pier will go ahead regardless of Federal plans. Although the pier is being constructed primarily to enhance in-season commercial and recreational activities, it will also encourage members of the winter fleet to remain at Camp Ellis Harbor by providing an improved terminal facility. It is probable that the continuation of the present hazardous winter conditions will lead to a continuing decline of commercial fishing activities during the winter season as more fishermen move away or seek other winter employment.

Transfer to Other Ports

During the winter season the major commercial activity at Camp Ellis Harbor is finfishing instead of lobstering as during the in-season. The finfishing grounds used by Camp Ellis fishermen located closer to their present anchorage than to any of the nearby alternative ports. Camp Ellis is also more convenient to major regional wholesale distributors.

Some fishermen who are based at Camp Ellis Harbor during the summer months transfer their vessels to other ports in order to continue winter operations with a reduced risk of damages. Many fishermen find transfer financially disadvantageous because of the costs involved in relocation of their shore support facilities and their vessels. Camp Ellis fishermen who do relocate during the winter months generally move to one of four nearby harbors. These are Biddeford Pool, Cape Porpoise, Kennebunkport or Pine Point. The locations of these harbors relative to Camp Ellis are shown in Figure 2-1.

Biddeford Pool is located at Wood Island Harbor, southeast of the mouth of the Saco River, and approximately 1.8 miles from Camp Ellis Harbor. Entrance to the pool from the relatively unprotected harbor is through a narrow gut. There is an existing Federal project consisting of a 10 acre anchorage, 6 feet deep mlw. The project also includes three ice breaker structures because the pool has its own ice damage problems. The shallow nature of both the pool and the gut restrict winter navigation to only shallow draft vessels. The shoaled condition in the gut also forces

fishermen to resort to tidal navigation causing delays and presenting a further hazard. The fees for use of the public pier at Biddeford Pool are also three times as high as those at Camp Ellis. Fees paid at Biddeford Pool are paid for a full year only, therefore Camp Ellis fishermen utilizing Biddeford during the winter are paying quadruple their yearly cost of anchorage. The pool at Biddeford is located further away from the area's commercial centers than Camp Ellis, necessitating a longer daily commute (14 miles round trip from Biddeford Pool to Camp Ellis) over less adequate roads. For these reasons relocation of the remainder of the Camp Ellis winter fleet to Wood Island Harbor/Biddeford Pool is considered impractical without also providing navigation improvements to Biddeford Pool.

Cape Porpoise Harbor is used as an alternative winter port by at least three Camp Ellis fishing vessels. The harbor is located approximately 7 miles south of the Saco River in Kennebunk. An existing Federal project completed in 1950 consists of a 16-foot mlw entrance channel, 200 feet wide leading to a 15-foot mlw anchorage that extends to the town wharf, and a 6-foot mlw, 100-foot wide channel extending from the town wharf to Porpoise Cove.

Cape Porpoise Harbor is located further from the Camp Ellis fishing grounds than Camp Ellis Harbor. Facility and mooring fees at Cape Porpoise Harbor are charged on a per pound of landings basis averaging $165 for the 4 month winter season. This is more than three times the yearly Camp Ellis rate resulting in a greater expense to relocating vessels. The round trip commuting time from Camp Ellis to Cape Porpoise is 35 miles resulting in considerable delays, lost fishing time, and added transportation expenses.

Cape Porpoise Harbor in Kennebunkport is currently the subject of an ongoing non-Federal study of the feasibility of providing a State funded public pier and other related shore facilities in order to transfer the overcrowding portion of the commercial fleet now operating out of the Kennebunk River to Cape Porpoise. The addition of any further vessels to the Cape Porpoise fleet in winter would strain the limits of this harbor's capacity. Also, vessels anchoring at Cape Porpoise would need to travel up the Kennebunk River into Kennebunk or Kennebunkport when in need of repairs or provisions. Therefore transfer of a significant portion of the Camp Ellis fleet to Cape Porpoise Harbor is considered impractical.

Kennebunkport is located on the Kennebunk River approximately 9 miles south of the Saco River. An existing Federal project consisting of an 8 foot mlw entrance channel with protective jetties, a 6-foot mlw main channel extending approximately 1 mile upriver, and a total of 6 acres of 6-foot mlw anchorage was completed in 1968. The Kennebunk River is currently the subject of an ongoing Corps of Engineers navigation study under Section 107.

Kennebunkport is even further distant from Camp Ellis than Cape Porpoise. The same per pound mooring fee is charged here. The round trip commuting distance to Cape Porpoise is over 40 miles resulting in considerable delays and added costs for fishermen living in the Camp Ellis area.

Currently Kennebunkport is experiencing problems relating to overcrowded anchorages and inadequate depths in the channel. The existing Kennebunk River fleet is already straining the limits of both the Federal navigation project and Kennebunkport's shore facilities on a year round basis. For these reasons the relocation of additional vessels of the Camp Ellis winter fleet to Kennebunkport is not considered practical.

Pine Point Harbor is located in the Scarboro River estuary approximately 7 miles north of the Saco River. There is an existing Federal project consisting of an 8 foot mlw entrance channel 200 feet wide with an 800-foot protective jetty, leading to a 6 foot mlw channel and a 14-acre six foot mlw anchorage. The existing project was completed in 1962. The round trip commute between Pine Point and Camp Ellis is 14 miles. The Scarboro River estuary also experiences winter ice flow problems. Related shore facilities are primarily designed to support recreational activities and there is only limited road access to the harbor through the village of Pine Point.

The lack of adequate support facilities and distance from fishing grounds makes transfer of a significant portion of the Camp Ellis winter fleet to the Scarboro River impractical.

Plans of Others

The city of Saco plans to construct improvements to its pier in the Saco River at Camp Ellis harbor regardless of the final findings on the Federal improvement proposal. It is unlikely that the city would also be able to provide the necessary capital to construct navigation improvements or any other protective structures.

It is unlikely that State funding for dredging at Camp Ellis Harbor would be made available. State participation in the pier improvements is being studied at this time by the Maine Department of Transportation. It is not expected that any further funding would be provided the city of Saco.

Of all the non-structural alternatives identified to date, none have adequately met the full range of local planning objectives as expressed in the problem and opportunity statements in Appendix 1.

FORMULATION OF STRUCTURAL IMPROVEMENTS

The development of new facilities namely providing navigation improvements including structures for ice protection is considered to be the most satisfactory means of meeting the needs of the winter commercial fishing fleet of Camp Ellis Harbor.

The formulation of structural plans involved identifying and quantifying the limits and requirements of any structural improvement measures. Data supplied by local officials and interests were quantified to develop the following steps to determine structural requirements.

Examination of Existing Operations

Data supplied by local sources was examined to determine the numbers, types, and sizes of the existing winter commercial fleet. Area interests were canvassed to determine how many fishermen who presently do not operate during the winter months would do so if an adequate safe anchorage were to be provided. Fishermen were also canvassed to determine the number and types of vessels in the Camp Ellis Harbor fleet that transfer to other ports in the area during winter. The volumes and types of catch both presently landed and expected from additional vessels were quantified for purposes of benefit analysis as were local estimates and records of damages due to ice flow. All of these parameters are discussed in detail in Appendix 5.

Establish Required Degree of Protection

In order to protect both the present and projected numbers of vessels using Camp Ellis Harbor for winter operations a total of 3 acres of anchorage with a depth of 6 feet mlw must be provided. A reduction in ice hazards to vessels offloading or taking on supplies at the public pier must also be achieved. The design of ice breakers, or jetty structures must account for the type and extent of ice flow encountered on the Saco River. These design parameters are discussed in further detail in Appendix 4.

Determine Alternative Structure Types

Structural solutions to the problem of providing for protection from ice flows include such measures as emplacement of pile ice breakers or construction of jetties. The type of material to be used to construct such structures depends upon many factors including climate, durability, design stress and required loading capability. Examination of these parameters led to the conclusions that any jetty constructed would be best designed as a rubble mound structure, and any ice breakers would be most effective as single steel piles driven into the riverbed. These and other engineering design parameters are discussed in detail in Appendix 4.

A preliminary evaluation of structural alternatives indicated that the jetty would have a negative impact on the river environment. The jetty would reduce the cross-sectional area of the river, altering tidal currents, river flow, and temperature and salinity gradients. All of these would have adverse effects on the river biota. Altering of tidal and river currents may also promote unnatural shoreline erosion. Since the jetty would almost totally block river currents from flowing through the anchorage from west to east it is conceivable that it may contribute to a worsening of chunk ice problems in the anchorage, and increase the formation of shore ice.

Construction of a jetty would result in a closed circulation system within the western portion of the anchorage thereby resulting in a long term degradation of water quality. The jetty effects on circulation would also lead to increased siltation within the anchorage, necessitating more frequent maintenance dredging.

Construction of a jetty would also result in the destruction of 0.6 acres of subtidal bottom habitat in the construction area and removal of a portion of the intertidal zone (0.7 acres) where the jetty connects to the shore. The jetty stones would colonized by a wide variety of subtidal and intertidal plant and animal life which would affix to the stones surfaces. Motile creatures would also be attracted to structure because of the shelter provided by gaps between the individual stone blocks.

The jetty alternative entails more adverse impacts on the river environment than icebreaker construction or a combination of new anchorage dredging and icebreaker construction.

Wildlife Mitigation Measures

Several environmental concerns relating to the proposed improvements were identified by interested parties. One of these concerns identified by the U.S. Fish and Wildlife Service would involve a structural solution. This would be necessary to mitigate against possible adverse effects of increased winter and in-season utilization of Camp Ellis Harbor upon the local osprey population. (There have been several sightings of ospreys in the Saco region.) The provision of a nesting platform to encourage the bird to remain and nest in the area would be part of any plan involving ice breaker structures. The platform would be placed atop a timber post attached to an ice breaker and would extend 25 feet above mean high water. One such platform would be provided in an attempt to encourage additional ospreys to nest in the estuaries. Detailed design of the platform is presented in Appendix 4.

DESCRIPTION OF DETAILED PLANS

As discussed in the previous sections four alternative plans of improvement were initially identified. Consideration of the negative economic and environmental impacts associated with construction of a jetty structure caused this alternative (as illustrated in Figure 2-3) to be dropped from further study in the detailed plan phase. Three plans were chosen for detailed analysis.

PLAN A

Plan A, as shown in Figure 2-2, consists of constructing a series of ice breaker structures to protect the existing 6 foot deep mlw north anchorage. The ice breaker structures would be located at the western end of the anchorage. A total of 15 ice breakers would be needed to provide adequate protection to vessels moored in the anchorage. Seven of the ice

breakers would extend in a line to the northwest of the anchorage from the channel limit towards the shore, while the remaining eight structures would extend to the east along the existing anchorage-channel boundary.

The ice breaker structures will consist of steel piles driven into the riverbed. No alteration of the existing anchorage would be performed and no dredging would be undertaken.

Cost estimates for Plan A are summarized in Table 2-1. Plan A is estimated to have an initial cost of $131,400 and would result in annual net benefits of $45,400.

In response to a suggestion by the U.S. Fish and Wildlife Service, one of the icebreaker structures would support an elevated nesting platform designed to attract ospreys. This wooden platform would be mounted atop a wooden post attached to the ice breaker. The platform would be 25 feet above mean high water. The design of the nesting platform is detailed in Appendix 4.

Table 2-1
Plan A - Project Cost Estimates

Ice Breakers - 15 at $6000 each	$ 90,000
Osprey Nesting Platform	3,000
Contingencies (20%)	18,600
SUBTOTAL	111,600
Engineering and Design	8,900
Supervision and Administration	8,900
SUBTOTAL	$129,400
Aids to Navigation	2,000
TOTAL FIRST COST	$131,400

Plan A - Annual Charges

Amortization (7-3/8%)	$ 10,000
Icebreaker Replacement (at year 25)	1,700
Maintenance of Aids to Navigation	500
TOTAL ANNUAL CHARGES	$ 12,200

Plan C

Plan C, as shown in Figure 2-4, consists of dredging a new 3 acre anchorage area east of the Saco town landing along the north side of the existing Federal channel. The anchorage would extend from a point 90 feet from the town landing approximately 750 feet along the northern limit of the 8-foot channel. The area would be approximately 200 feet wide for most of its length. The anchorage would be dredged to 6-feet mlw.

In order to protect the new anchorage from ice flow 13 ice breaker pilings will be provided. A total of 13 pilings will be emplaced under Plan C. A series of 9 ice breaker structures would be needed to protect the anchorage along its boundary with the channel. However no structures would be necessary along much of the western side of the anchorage since it is protected by the town landing. Two ice breaker structures would also have to be located between the western limit of the anchorage and the city pier to provide maximum protection. The ice breakers placed along the channel boundary would be spaced approximately 50 feet apart, so as to allow for safe navigation between the piles. Two ice breaker pilings would also be emplace above the city pier to protect the wooden piles of the dock and vessels offloading and maneuvering at the end of the dock.

As with Plan A, one of the ice breaker piles required by Plan C would support an osprey nesting platform at an elevation of 25 feet above MHW.

Plan C would involve the dredging of approximately 9,400 cubic yards of sand and gravel. Approximately 0.3 acres of intertidal zone would be removed, and 0.5 acres would have altered depths.

Cost estimate for Plan C are summarized in Table 2-3. Plan C is estimated to have an initial cost of $237,700, and would result in annual net benefits of $121,700.

Table 2-2
Plan C - Project Cost Estimates

Dredging - 9,400 c.y. of sand and gravel @ $9.25/c.y.	$86,900
Ice Breakers - 13 @ $6,000 each	78,000
Osprey Nesting Platform	3,000
Contingencies (20%)	33,600
SUBTOTAL	$201,500
Engineering and Design	16,100
Supervision and Administration	16,100
SUBTOTAL	$233,700
Aids to Navigation	4,000
TOTAL FIRST COST	$237,700

Plan C - Annual Charges

Interest & Amortization (7-3/8%)	$ 18,000
Maintenance Dredging - 800 c.y. of sand and gravel @ $10.75 c.y.	8,600
Icebreaker Replacement (at year 25)	1,400
Maintenance of Aids to Navigation	1,000
TOTAL ANNUAL CHARGES	$29,000

PLAN D

Plan D, as shown in Figure 2-5, entails the dredging of a 3 acre anchorage to 6-feet mlw in the area south of the Saco town landing along the northern limit of the existing 8-foot Federal channel.

The anchorage would be protected on the west by being in the shadow of the city landing. Unlike Plan C, this anchorage entails less frontage along the channel and would have a greater width. The shoreward limit of the anchorage would have a distance of 50 feet between the outer limit of its side slope and the existing city built stone jetty which protects the sand spit from erosion. The western limit of the anchorage would be more parallel to the city landing in order to decrease frontage on the channel while taking maximum advantage of the protection provided by the city pier. This plan would minimize the number of ice breaker piles needed to provide optimum protection.

As with the previous plans involving the emplacement of ice breaker structures, one of the piles would support an osprey nesting plaform.

Cost estimates for Plan D are summarized in Table 2-4. Plan D has an estimated first cost of $260,900, and would result in annual net benefits of $121,700.

Plan D would entail the dredging of 12,500 cubic yards of sand and gravel which would be used for beach nourishment purposes at Camp Ellis Beach. Plan D would involve the removal of 1.0 acres of the intertidal zone, and alteration of depth in an additional 0.5 acres.

Table 2-3
Plan D - Project Cost Estimates

Dredging - 12,500 c.y. of sand and gravel at $9.25/c.y.	$115,600
Ice Breakers - 11 at $6,000 each	66,000
Osprey Nesting Platform	3,000
Contingencies (20%)	36,900
Engineering and Design	17,700
Supervision and Administration	17,700
SUBTOTAL	$256,900
Aids to Navigation	4,000
TOTAL FIRST COST	$260,900
Plan D - Annual Charges	
Interest & Amortization (7-3/8%)	$ 19,800
Icebreaker Replacement (at year 25)	1,200
Maintenance Dredging (1,050 of sand and gravel at $10.75 cy)	11,300
Maintenance of Aids to Navigation	1,000
TOTAL ANNUAL COST	$ 33,300

SECTION C

EVALUATION AND COMPARISON OF DETAILED PLANS

EVALUATION OF DETAILED PLANS

General Evaluation

All three of the alternative plans of improvement involve several benefits and impacts common to each. The riverbed would be disturbed and permanently altered under all of the plans to varying degrees. Each plan would provide for 3 acres of protected anchorage for the winter fleet. This allows expansion of the winter fleet to 15 or 16 vessels of the size and type presently used by Saco fishermen.

Construction activities such as pile driving and dredging will all cause temporary and minimal degradation of the water column due to increased turbidity and release of sediment trapped pollutants. The driving of the steel ice breaker pilings into the riverbed sediments will cause negligable turbidity increases and will permanently destroy a very small area of benthic habitat, approximately 452 square inches of bottom surface per piling. The U.S. Fish and Wildlife Service in a letter dated 16 January 1979 (see Appendix 3) stated that this loss of benthic habitat "is expected to be more than offset by plant and animal communities that will become attached to intertidal and subtidal portions of the pilings."

Two of the plans involve dredging of a new 3-acre anchorage downstream of the city pier in order to take advantage of its shielding effect and protection afforded against ice flows. Dredging will cause a temporary increase on turbidity. The use of a hydraulic dredge pump which sucks material into a pipe will minimize turbidity increases. The construction of a new anchorage will permanently destroy a limited area of the intertidal zone and alter depths in an additional portion of the zone. This altered area will be recolonized by subtidal creatures after dredging and icebreaker construction is complete.

Disposal of dredged material as beach nourishment sand on Camp Ellis Beach is economically and environmentally the most acceptable disposal method as detailed in the Environmental Assessment in the main report. The beach nourishment is also a desire of Camp Ellis residents since it would serve to provide increased protection from wave erosion and surf to shorefront properties along the southern portion of the beach. The benthic tidal and nearshore creatures that inhabit the beach in the disposal area would be buried. Recolonization would take place fairly quickly. Reworking and washing of the disposed sand by waves and currents would be complete by the summer season since construction is planned for colder months in order to minimize impacts on the environment and the aesthetics of the beach.

The construction and implacement of protective structures such as ice breakers will create permanent obstacles in the river which will have to be avoided. Provision of aids to navigation by the U.S. Coast Guard will minimize this potential navigation hazard. In the case of ice breakers they would be spaced approximately 50 feet apart, quite enough room for even the largest vessels using the anchorage area to maneuver through them.

The increased size and reduction in damages of the winter fleet at Camp Ellis Harbor will provide additional jobs and revenue to the community.

Under all plans problems with chunk ice forming in the anchorage would remain unchanged. There would still be some problems with sheet ice presenting a hazard to navigation in the channel and at the entrances to the anchorage.

Plan A - Evaluation

Plan A would entail no dredging since the area to be protected by icebreakers is the upstream half of a 6-acre Federal anchorage maintained to 6-feet mlw. The 15 ice breakers, consisting of piles would have a negligible effect on the river's biota or current patterns. There would be no detrimental effect on the adjacent shoreline and the piles would provide a habitat for a wide range of plants and animals that affix themselves to intertidal and subtidal objects. The wooden nesting platform provided would serve as a nesting area for ospreys or other birds.

Plan A would have minimal environmental impact on the river. The riverbed would be disturbed during construction but upon completion of icebreaker installation, the system would have a negligible effect on the river's biota and currents and piles would provide a habitat for barnacles and mussels. The pile structures would not increase currents in the river to a measureable degree, therefore, there would be no detrimental effects upon adjacent landforms. Plan A would permit some increased winter utilization of Camp Ellis Harbor and reduce ice damages sustained by the winter fleet. The plan would provide adequate protection from sheet ice floes to anchored craft. However, sheet floes will still be able to flow through the eastern half of the anchorage and may cause difficulty for craft entering or exiting the anchorage. Problems with chunk ice would remain unchanged as chunk ice would still form in the anchorage and shoreward of the anchorage. Due to a lesser salt content than waters seaward of the city pier because of current action and the constriction in the river caused by the city pier, sheet ice usually forms along the shoreline and out into Camp Ellis Harbor in the area immediately upstream of the city pier. Historical observations indicate that this condition would be present for approximately 2-1/2 months of the 4 month winter fishing season. Although the placement of icebreakers would break and deflect ice moving down the open main channel, sheet ice would continue to

extend outward from the shore and into the anchorage area during the winter months restricting the use of this area as a winter anchorage. This is seen in the limited ice movement data presented in Appendix 4. Therefore, the upstream anchorage would only be useful for 30-45 days during the winter fishing season since it would be subject to icing conditions for most of the winter fishing season.

Plan C - Evaluation

Plan C would provide a protected 3-acre anchorage east of the existing town landing. The anchorage would be protected from sheet ice by the shielding effect of the town landing to the west, and by ice breaker piles to the south along the channel.

Historically little to no chunk ice forms downstream from the city landing, since from this point seaward the estuary widens and there are no obstructions to restrict flow and lead to surface freezing or large accumulations of shore ice. Therefore the chunk ice and shore ice problems can be alleviated by placement of an anchorage east of the city landing.

The icebreakers would have only negligible impacts on the river environment with the exception of providing a habitat for mussels, barnacles and other organisms which would affix themselves to the piles. The osprey nesting platform to be affixed to the second eastern most of the icebreakers placed along the channel limit would provide a nesting area for ospreys or other birds.

Plan C involves the dredging of approximately 9,400 cubic yards of sand and gravel, permanently altering 3 acres of river bottom, 0.3 acres of which would be removed from the intertidal zone. A further 0.5 acres of intertidal zone would be altered in depth. Destruction of the bottom habitats is only temporary however since recolonization of the deepened anchorage bottom would take place over time.

Disposal of the dredged sand would take place on Camp Ellis Beach where the material would be used for beach nourishment purposes. Dredging and disposal would cause temporary increased levels in turbidity and resulting temporary degradation of water quality. Since the material is assumed to be composed of predominantly clean sand and gravel only very limited release of sediment trapped pollutants is expected to occur. Reworking and washing of the disposed sand by waves, currents and storms will take place before the summer season since construction would take place during the winter months.

Plan C, through providing a greater degree of ice protection than the plans associated with the existing anchorage would result in greater net benefits to the commercial winter fleet. Investigations by the Corps of Engineers, Cold Regions Research and Engineering Laboratory at Hanover, N.H. identified the area immediately downstream of the city pier as being

the safest location for a winter anchorage. The pier would have a shielding effect on ice flows moving east downstream thereby providing an increased degree of protection.

Plan D - Evaluation

As in Plan C, Plan D provides for 3 acres of protected anchorage east of the existing Saco town landing. The anchorage proposed in Plan D, however, while containing the same amount of area (3.0 acres), has less frontage on the channel and extends further back towards the shore and further upstream towards the city pier. Ice breaker piles will be constructed along the boundary between the channel and the anchorage, and between the pier and the channel at both ends of the pier.

The outer limit of the 1:3 side slopes of the 6-foot mlw anchorage would be no less than 50 feet from the existing protective shore jetty built by the city of Saco and no less than 90 feet from the existing town landing pier so as not to structurally affect these features by leading to the undermining of their foundations.

Since Plan D involves anchorage dredging closer to shore the volume of dredged material will be greater than that in Plan C. A greater area of the intertidal zone, approximately 1.0 acres will be removed. A further 0.5 acres of the intertidal zone will be altered. A temporary destruction of 3 acres of bottom habitat will be experienced, however recolonization of the new anchorage bottom will take place over time.

The ice breaker piles will not have any major adverse effect upon the river biota and will provide a habitat for marine plants and animals such as mussels and barnacles. The osprey nesting platform positioned above one of the piles would hopefully provide a nesting area for ospreys and other birds.

As in Plan C, chunk ice is not expected to be a problem since no history of chunk ice or shore ice forming east of the Saco city landing has been identified. However, there will still be a minor ice hazard to vessels entering and leaving the anchorage from ice flow in the channel. Plan D provides a level of protection from all types of ice problems similar to Plan C, since it takes maximum advantage of the protection afforded by the city dock and pier.

The material dredged to construct the anchorage in Plan D is expected to be predominantly clean sand and gravel and will be used for beach nourishment purposes to widen Camp Ellis Beach. Dredging and disposal of dredged material are not expected to cause the release of sediment trapped pollutants due to the relatively clean and coarse nature of the sediments in question. Reworking of the nourishment sand by waves, currents and storms will take place before the summer season since winter construction is planned.

COMPARISON OF DETAILED PLANS

General Comparison

Generally the three plans can be categorized as being of two types. Plan A involves improvement measures aimed at protecting the western half of the existing northern Federal anchorage. This plan therefore require no dredging nor do they entail the adverse environmental impacts associated with dredging or the environmental benefits to be gained by providing sand for beach nourishment at Camp Ellis Beach. This plan also fails to protect against chunk and shore ice buildup and related damages and therefore provide less economic benefits than the other two plans.

The dredging plans (C and D) yields greater benefits by providing greater utility and protection from ice damage. The dredging plans also entail benefits derived from the beach nourishment plan. Both dredging plans have the adverse environmental impacts associated with dredging such as temporary destruction of benthic habitats, temporary degradation of water quality and the release of sediment trapped pollutants to the water column.

Trade-Off Analysis

There is generally a trade-off between the degree of protection provided by a plan and the amount of dredging. The two dredging plans provide the greatest degree of protection from all types of ice while Plan A fails to provide relief from damages attributable to chunk ice and shoreline ice buildup.

Plan A provides the least degree of protection and entails the minimum amount of construction and costs. Plan A also entails the least amount of impacts on the environment and the least social impacts. Plan A provides the least net benefits.

Plan C provides the greatest net benefits of any of the proposed plans, the sheltering effect of the city pier on the downstream anchorage provides a greater degree of protection than ice breakers and thereby minimizes the number of ice breakers needed. The greater cross-sectional area of the estuary below the landing results in a lesser degree of chunk and shore ice formation than that in the existing anchorages above the city landing. Plan C provides for protection of the wooden pilings of the city dock and proposed extension by the provision of two ice breakers upstream of the pier. These two icebreakers also serve to protect vessels offloading and maneuvering at the end of the pier.

Plan C entails the usual temporary adverse impacts associated with dredging as discussed earlier in this section and the benefits derived from beach nourishment and the provision of an osprey nesting platform.

Plan D provides a level of protection similar to Plan C. Plan D also entails the greatest amount of dredging and therefore fails to optimize net benefits as does Plan C. Plan D involves the least number of ice breaker structures and the greatest extent of beach nourishment.

In order to provide its level of protection, Plan D involves the dredging of an anchorage which extends closer to the shoreline and the city landing. This would result in removal of a greater portion of the intertidal zone (1.0 acres) and therefore greater long-term environmental impacts than any other alternative plan. This adverse impact is only partially mitigated by the provision of a nesting platform.

Plan D provides for two ice breaker pilings emplaced upstream of the city pier as does Plan C. These ice breakers serve to protect the wooden dock pilings and vessels offloading and maneuvering at the end of the pier.

System of Accounts

The System of Accounts is a summary comparison of the alternative plans required by the Principles and Standards. The System of Accounts provides in a concise format an evaluation of the alternative plans in terms of the national objectives of National Economic Development (NED), Environmental Quality (EQ), national accounts of Social Well Being (SWB) and Regional Development (RD). It also demonstrates plan performance in terms of the planning objectives and constraints; the technical, economic and other criteria, as well as other measures such as plan acceptability.

The System of Accounts is shown in Table 2-4. The summary assessments indicate that the plans have varying responses to the different national objectives and accounts. In evaluating all impacts considered, Plan C is shown to be the most favorable option considered.

TABLE 2-4
SYSTEM OF ACCOUNTS

	PLAN A	PLAN C	PLAN D
Structures - Federal		-dredging 3-acre anchorage 11 icebreaker structures	-dredging 3 acre anchorage 13 icebreaker structures
Structures - Local	structurally strengthen city pier	Same as A	Same as A
NATIONAL ECONOMIC DEVELOPMENT			
Implementation Costs			
Federal	$131,400	$237,700	$260,900
Non-Federal	0	0	0
QUANTIFIABLE TOTAL			
Average Annual Benefits			
Increased Net Income to Fishermen	42,300	112,800	112,800
Transportation Savings	600	1,600	1,600
Reduction in Damages		1,500	1,500
Elimination of Extra Fees	2,500	3,500	3,500
Elimination of Boat Hauling		2,300	2,300
TOTAL	45,400	121,700	121,700
Average Annual Costs			
Interest & Amortization	10,000	18,000	19,800
Maintenance (Anchorage)	2,200	11,000	13,500
TOTAL	$ 12,200	$ 29,000	$ 33,300
Benefit-Cost Ratio	3.7	4.2	3.6
ENVIRONMENTAL QUALITY			
Water Quality			
Turbidity at Dredge Site	-	Yes	Yes
Effluent Discharge at Dredge Site	-	No	No
Icebreakers Interface with Tidal Currents	Minimal	Minimal	Minimal
Icebreakers Impact Water Quality		No	No
Shoreline Impacts	No	Yes	Yes
AIR QUALITY			
Increased Fuel Emissions from Vessels and Vehicles	Yes	Yes	Minor
Short Term Noise at Construction Area	Yes	Yes	Yes
Short Term Marine Odor During Dredging Operations	-	Minor	Minor

TABLE 2-4 (Cont'd)
SYSTEM OF ACCOUNTS

	PLAN A	PLAN C	PLAN D
LAND USE			
Intertidal Zone Lost	None	0.3 acre	1.0 acre
Commercial Land Use Disrupted	none	none	none
Residential Land Lost	none	none	none
Recreational Land Lost	none	none	none
Wildlife Area Lost	none	none	none
PLANTS			
Terrestrial Vegetation Destroyed	No	No	No
Aquatic Vegetation Destroyed	No	No	No
ANIMALS			
Wildlife Displaced	No	No	No
Wildlife Destroyed	No	No	No
Temporary Disruption of Fish Habitat	Yes	Yes	Yes
Permanent Disruption of Fish Habitat	No	No	Yes
Benthic Fauna Destroyed	Yes	Yes	Yes
SOCIAL WELL-BEING			
Disrupts Recreational Activities	No	No	No
Project Makes Maximum Use of Existing Facilities	No	Yes	Yes
Commercial or Residential Relocation Necessary	No	No	No
Community Growth	slight increase in fishing activity	increased fishing activity	increased fishing activity
Transportation	minor inconvenience to traffic during icebreaker placement	construction related disruption more critical in channel than in anchorage	Same as C
Displacement of People	No	No	No
Recreational Opportunities	No	Yes	Yes
REGIONAL DEVELOPMENT			
Supports Commercial Growth	No	Yes	Yes
Provides Service and Maintenance Facilities	No	No	No
Non-Federal Government Funds Required for Implementation of Portion of Project	No	No	No

TABLE 2-4 (Cont'd)
SYSTEM OF ACCOUNTS

	PLAN A	PLAN C	PLAN D
OTHER EVALUATED CRITERIA			
Minimizes Adverse Social Impacts	Yes	Yes	Yes
Navigation Benefits Exceed Costs	Yes	Yes	Yes
Plan is Acceptable to City	No	Yes	Yes
Plan is Acceptable to Private Concerns	No	Yes	Yes
Plan is Acceptable to Other Federal Agencies			
Plan is Acceptable to Regional Concerns			

SECTION D

SELECTING A PLAN

SELECTION RATIONALE

Before selecting a plan of improvement for Camp Ellis Harbor, all of the planning needs and objectives of State and local governments as well as national objectives and policy must be taken into consideration. Each alternative plan has been evaluated and compared on the basis of the stated criteria of economic efficiency, preservation of environmental quality, navigational safety, and prevention of ice damages. Considerations of Federal policies including contributions to national economic development and enhancement of environmental quality were considered. The plan which met all of the objectives and provided the greatest net benefits is the selected plan. Based on these criteria, Plan C is found to be overall the most favorable plan for meeting the project objectives.

THE NATIONAL ECONOMIC DEVELOPMENT PLAN

Each of the alternative plans were evaluated according to their level of contribution to national economic development. The level of contribution is determined through summation of the benefits and adverse economic effects attributed to each plan. Benefits relative to improvement plans for Camp Ellis Harbor include changes in gross revenues/increased landings, and changes in associated costs/reduced damages. Descriptions of the benefit and cost analysis of the economic and biological study areas, relative to each of the detailed plans is contained in Appendix 5.

Based upon all considerations relative to national economic development objective, Plan C, has been designated as the National Economic Development plan, since it provides the greatest net benefits.

THE ENVIRONMENTAL QUALITY PLAN

The environmental quality plan is the alternative that makes the most significant contribution to the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems. Plan A is the designated Environmental Quality Plan.

Each of the three plans, A, C, and D which involve the emplacement of ice breaker piles, contribute to the conservation of natural resources and preservation of ecological balance through the incorporation of an osprey nesting platform into their design. This measure is intended to mitigate against the adverse effects of increased vessel traffic on waterfowl which nest in the estuary area, and is not considered to constitute a significant contribution.

The plans do, however, have varying degrees of environmental impact. The plan which has the least impact on the environment is Plan A, which involves emplacement of ice breakers and no dredging. Although placing the icebreakers would destroy that habitat directly underneath the piles, the piles would offer new subtidal and intertidal habitat for plant and animal life. Therefore, Plan A, which involves the minimum amount of environment disruption, while adding new and larger areas for plant and animal communities is designated as the EQ Plan. Plan A is not the selected plan, however, since it fails to provide adequate protection to moored vessels.

THE SELECTED PLAN

Plan Description

Based on the selection rationale discussed previously, Plan C has been designated as the selected plan of improvement. As shown in Figure 2-6, and as described in more detail earlier in this Appendix, Plan C consists of dredging 9,400 cubic yards of sand from a 3-acre area east of the existing Saco city landing to form a 6-foot mlw anchorage. The plan provides for a protected winter anchorage through the emplacement of 13 ice breaker pilings driven into the riverbed along the boundary of the proposed anchorage and existing eight foot mlw Federal channel. Table 2-5 summarizes the major features of Plan C.

Table 2-5
PERTINENT DATA - THE SELECTED PLAN

Anchorage

Area	3 Acres
Depth	6 feet mlw
Side Slopes	1:3
Dredge quantity-sand in cubic yards	9,400 c.y.
Maintenance Dredging	
Average Annual	800 c.y.
Over 6 years	4,800 c.y.

Ice Breakers

Diameter of Pile	24 inches
Length of sand filled steel pile	45 feet
Wall thickness of pile	1/2 inch
Height of top of pile above mlw	15 feet
Depth of bottom of pile below mlw	-30 feet
Average - depth driven below riverbed	22.6 feet
Design Impact (lbs per square inch)	200 psi
Interval between piles	50 feet
Number of Piles	13

Table 2-5 (Cont'd)

Nesting Platform

Height above mlw	35 feet
Length of wooden supporting pole	45 feet
Diameter of pole	12 inches
Platform area-square feet	16 sq feet
Sideboard height	6 inches

Evaluated Accomplishments

The evaluated accomplishments that would result from the selected plan of improvement are benefits that would accrue to the winter commercial fishing fleet of Camp Ellis Harbor and related industry of the Saco area. Additional benefits will result from the use of the dredged material for beach nourishment and the provision of nesting platforms designed for ospreys.

The proposed plan would alleviate the unsafe winter mooring conditions by providing an anchorage protected from ice hazards. The plan would lessen the degree of damage to vessels active during the winter season, and would encourage more Camp Ellis area fishermen to join the winter fleet instead of hauling their boats out of the water and seeking other winter employment.

The selected plan will result in quantifiable net annual benefits of $121,700.

General Impacts of Construction

The construction of the proposed plan will have both temporary and long-term effects on the environment and the community. Short term effects include temporary disruptions of commercial activity, air pollution, noise and degradation of water quality due to construction and dredging activities. Long-term effects relate primarily to an increased level of winter commercial fishing operations.

Water Quality Impacts

Short term impacts on water quality will result from oil and grease discharges from dredging equipment, from increases in turbidity, and from the reintroduction of sediment trapped pollutants. Disposal of dredged material will also cause some temporary environmental effects. Of these short term impacts, the increase in turbidity is generally the most serious. Suspended fine sediments in the water can have a detrimental effect on shellfish and finfish. However, the sediments to be dredged at Camp Ellis Harbor are coarse and are not expected to contain any significant levels of sediment trapped pollutants. Dredging is to be accomplished by use of a hydraulic dredge which will suck the material

into a pipeline and transport it directly to the beach nourishment site. This method of dredging induces less turbidity at the dredge site than other methods of dredging. Turbidity at the beach disposal site from surf and tidal washing of the dredged material will decline with time and cease after the first several subsequent storms.

Impacts on Other Harbor Improvements

The city of Saco is planning the extension of the existing town pier and landing. Presently the city's plans call for extending the existing pier 50 feet closer to the northern limit of the existing Federal 8 foot channel. This will not result in the new pier being any closer to the proposed anchorage than the planned 90 feet. The anchorage will be located far enough from the pier to ensure that construction dredging and the eventual natural stabilization of side slopes will not adversely effect the stability of the pier or the planned pier extension.

Impacts on Air Quality

Temporary air pollution impacts will occur during construction. Engine exhaust emissions from the dredging equipment and support vehicles will be quickly dispelled by prevailing winds and are not judged to be significant. The release of toxic materials in trace amounts might be facilitated during dredging operations. Since the greatest concentrations of heavy metals and other contaminants are known to be associated with silt-clay sediments little or no impact of such release would be predicted at the dredge site.

In the long-term, encouraging more Saco area fishermen to join the winter fleet at Camp Ellis Harbor will lead to more exhaust emissions from fishing vessels and shore support vehicles on a regular basis. This is expected to have no adverse long-term impact on air quality in the immediate area of Camp Ellis Harbor during the winter months.

Impacts on Marine and Other Wildlife

A variety of marine organisms will be affected by the proposed plan of improvement. The majority of these are benthic invertebrates, such as polychaete worms and burrowing bivalves, which live on or in the sand of the river bottom. The dredging of the anchorage will require the destruction of 3 acres of bottom habitat. The post construction stabilization of side slopes will further alter a portion of bottom habitats. The deepening of this section of the river bottom will permanently alter tidal and river currents in the immediate area of the proposed anchorage. Recolonization of the new anchorage bottom by benthic invertebrates will begin shortly after construction and eventual total recolonization would be reached in 1 to 2 years.

The dredging of the anchorage area and natural stabilization of side slopes will impact on the intertidal zone of the estuary below the city

pier. The intertidal zone is an ecologically valuable area as a source of food for finfish and other creatures. Approximately 0.3 acres of the intertidal zone will be permanently removed by dredging. A further 0.5 acres will be altered by deepening but will remain above mlw. Recolonization of the removed area will occur over time with subtidal creatures moving into this area. Intertidal species will recolonize the altered area.

During construction motile creatures, such as lobsters, and finfish will evade the construction site during dredging operations and therefore will not be significantly affected by the increased turbidity. These creatures would recolonize the area soon after construction operations cease and the suspended sediment level in water column returns to normal.

Disposal of the dredged sand on Camp Ellis Beach will bury organisms presently inhabiting the intertidal beach area and near shore area. Most of these organisms will be polychaete worms and burrowing bivalves. These organisms will begin recolonization shortly after disposal.

Emplacement of ice breakers by driving or jetting the piles into the river bottom will temporarily increase turbidity in the immediate area and destroy a negligible portion of the bottom habitat. The pile itself will become a new habitat for aquatic vegetation and animals such as mussels and barnacles.

The U.S. Fish and Wildlife Service is of the opinion that the construction a nesting platform atop one of the icebreakers may encourage ospreys to nest in the estuary. There have been no recent confirmed sightings of ospreys in the Saco estuary, however it is expected that other birds would make use of the platforms in the absence of any ospreys. Sea birds and other fowl will enjoy a temporary increase in available food supply during disposal operations at Camp Ellis Beach. Benthic invertebrates and other creatures caught in the dredge suction and deposited on the beach will be easy prey for birds and other predators and scavengers. An increased level of winter commercial activity will also attract more scavenging animals to the anchorage area, namely birds.

These and other environmental concerns are discussed in greater detail in the environmental assessment section found in the main report.

Economic Impacts

The provision of 3 acres of protected winter anchorage will result in an increased level of economic activity related to expanded winter finfishing operations. Fishermen would benefit from reduced ice damages, more fishing time, increased catch, and greater revenues. This will lead to an overall enhancement and growth of the economy of the Camp Ellis Harbor - Saco area primarily in industries related to the processing, packaging, and transportation of finfish and other seafood. Over time,

increased returns on increased winter catches will enable and encourage Camp Ellis fishermen to invest in larger modern vessels leading to a further economic development of the area.

Impacts on Social Well Being

A protected winter anchorage will upgrade the social well being of the Camp Ellis Harbor - Saco area primarily due to the economic benefits derived from the proposed plan. By protecting the anchorage from ice flows a positive impact on the health and safety of the Camp Ellis fishermen will be achieved. However, the ice breaker piles are permanent structures and care must be taken to avoid them while navigating into and out of the anchorage area.

Disposal of the dredged sand will take place at Camp Ellis Beach where it will be used for beach nourishment. Rehabilitation of the beach will enhance this natural resource and provide additional protection to those residential structures located directly behind the beach.

SECTION E

CONSTRUCTION AND MAINTENANCE

PROJECT CONSTRUCTION

The dredging contract will specify that the contractor form an anchorage area of 3 acres, with a minimum depth of 6-feet at mlw with a 1 foot allowable overdepth and side slopes of one on three slope. Since a portion of the anchorage is to be constructed in a shallow area, dredging work may have to be scheduled according to the height of the tide.

The contract will specify that the contractor pump the dredged material across the Camp Ellis spit and deposit it along a 500 foot long section of Camp Ellis Beach immediately above the north breakwater.

Typical equipment that could be used for the dredging contract include:

12" Hydraulic Dredge Pump - 800 horsepower
One Tug - 400 horsepower
One Launch - 165 horsepower
One Derrick Barge
One Pipe Barge
Pontoon Pipe #90 L.F. - 500 feet
Shore Pipe #3 L.F. - 500 feet

The contract will specify that a total of 13 ice breaker pilings be emplaced at locations as shown on Figure 2-6. The pilings will be constructed of steel pipe with a 24-inch outside diameter with a wall thickness of 1/2 inch. The piles will be 45 feet long and will be driven into the riverbed to a depth of -30 feet mlw. The piles will be filled with sand and the top of the pile will stand at 15 feet above mlw or approximately 4.5 to 5 feet above mhw. The ice breakers will be designed and emplaced so as to be able to withstand an ice flow collision of approximately 200 pounds per square inch.

The contract will specify that a nesting platform will be constructed atop the second easternmost of the ice breaker pilings. The nesting platform will be made of wood and will be supported by a 45-foot wood support at an elevation of 35 feet above mean high water. The platform will have an area of 16 square feet and sideboards 6 inches high. The wood support will be emplaced inside the steel ice breaker piling to a depth of 25 feet below the top of the pile so that the bottom of the wooden pole will be at -10 feet mlw and the platform will be 20 feet above the top of the ice breaker. As shown in detail in Appendix 4, Figure 4-20, the platform would be composed of 2 x 6 inch floor slats and braced to the wooden support pole with 6 foot braces.

Construction is estimated to take 1 month, with dredging operations lasting 1/2 month.

PROJECT MAINTENANCE

The 3-acre dredged anchorage will experience gradual shoaling limiting use of the anchorage at lower tides to shallow draft vessels. Wind swept sand from adjoining beaches and fluvial sand deposits left by the river will slowly fill in the anchorage at a rate of approximately 8-1/2 percent of the material originally dredged per year. Periodic maintenance dredging of the anchorage will be required to assure the safety and efficiency of vessel navigation and commercial operations.

Presently the existing Federal channel and other portions of the Federal project in the Saco River require maintenance dredging at an interval of approximately 10 years. The existing Federal project was last dredged in 1978. The proposed new anchorage will be maintained at the same time as the remainder of the existing Federal project in order to reduce maintenance costs. It is expected that disposal of material dredged during maintenance operations will be deposited on adjoining beaches as is proposed for material dredged during construction. Maintenance dredging of the anchorage will require the removal of approximately 4,800 cubic yards every 6 years. The cost of maintenance dredging of the proposed anchorage is estimated at $51,600 every 6 years or $8,600 each year.

The ice breaker pilings may also require periodic replacement. It is estimated that each pile will require replacement on the average of once every 25 years. The cost of replacement of piles at 25 and 50 years after initial construction is included in the first cost of of the project.

The U.S. Coast Guard will be required to maintain the aids to navigation for the proposed project as needed. The average annual cost for maintaining aids to navigation is estimated at $1,000.

Maintenance of the Federal project would be contingent upon the availability of maintenance funds.

IMPLEMENTATION RESPONSIBILITIES

Cost Allocation

Allocation of the initial costs of project construction are 50.9 percent to dredging of the anchorage and disposal 45.7 percent to construction and emplacement of ice breakers, 1.6 percent to providing aids to navigation and 1.8 percent to construction of the nesting platform. There are no other elements of the Federal project.

Cost Apportionment

The provision of a protected winter anchorage at Camp Ellis Harbor is solely for the benefit of commercial fishing interests. According to current Federal policy the initial cost of construction of any Federal navigation project that is solely for the benefit of commercial interests will be borne fully by the Federal government subject to the Federal cost limitation of $2,000,000 under the Section 107 program.

Federal Responsibilities

Since this project is for the exclusive benefit of commercial fishing operations, the Federal share of the cost of construction will be 100 percent or $259,900.

The Federal government will be responsible for 100 percent of the costs of periodic maintenance dredging of the proposed anchorage necessitated by natural shoaling, and ice breaker maintenance, contingent upon the availability of maintenance funds.

Local Responsibilities

Local responsibilities are as follows:

- Provide, maintain and operate without cost to the United States, an adequate public landing with provisions for the sale of motor fuel, lubricants and potable water open and available to the use of all on equal terms.

- Provide without cost to the United States all necessary lands, easements and rights-of-way required for construction and subsequent maintenance of the project including suitable dredged material disposal areas with necessary retaining dikes, bulkheads and embankments.

- Hold and save the United States free from damages that may result from construction and maintenance of the project.

- Accomplish without cost to the United States alterations and relocations as required in sewer, water supply, drainage and other utility facilities.

- Provide and maintain berths, floats, piers, and similar marina and mooring facilities as needed for transient and local vessels as well as necessary trailer facilities, access roads, parking areas and other needed public use shore facilities open and available to all on equal terms. Only minimum, base facilities and service are required as part of the project. The actual scope or extent of facilities and services provided over and above the required minimum is a matter of local decision. The manner of financing such facilities and services is a local responsibility.

- Assume full responsibility for all project costs in excess of the Federal cost limitation of $2 million under the 107 program.

- Establish regulations prohibiting the discharge of untreated sewage, garbage, and other pollutants in the waters of the harbor, said regulations being in accordance with applicable laws and regulations of Federal, State and local authorities responsible for pollution prevention and control.

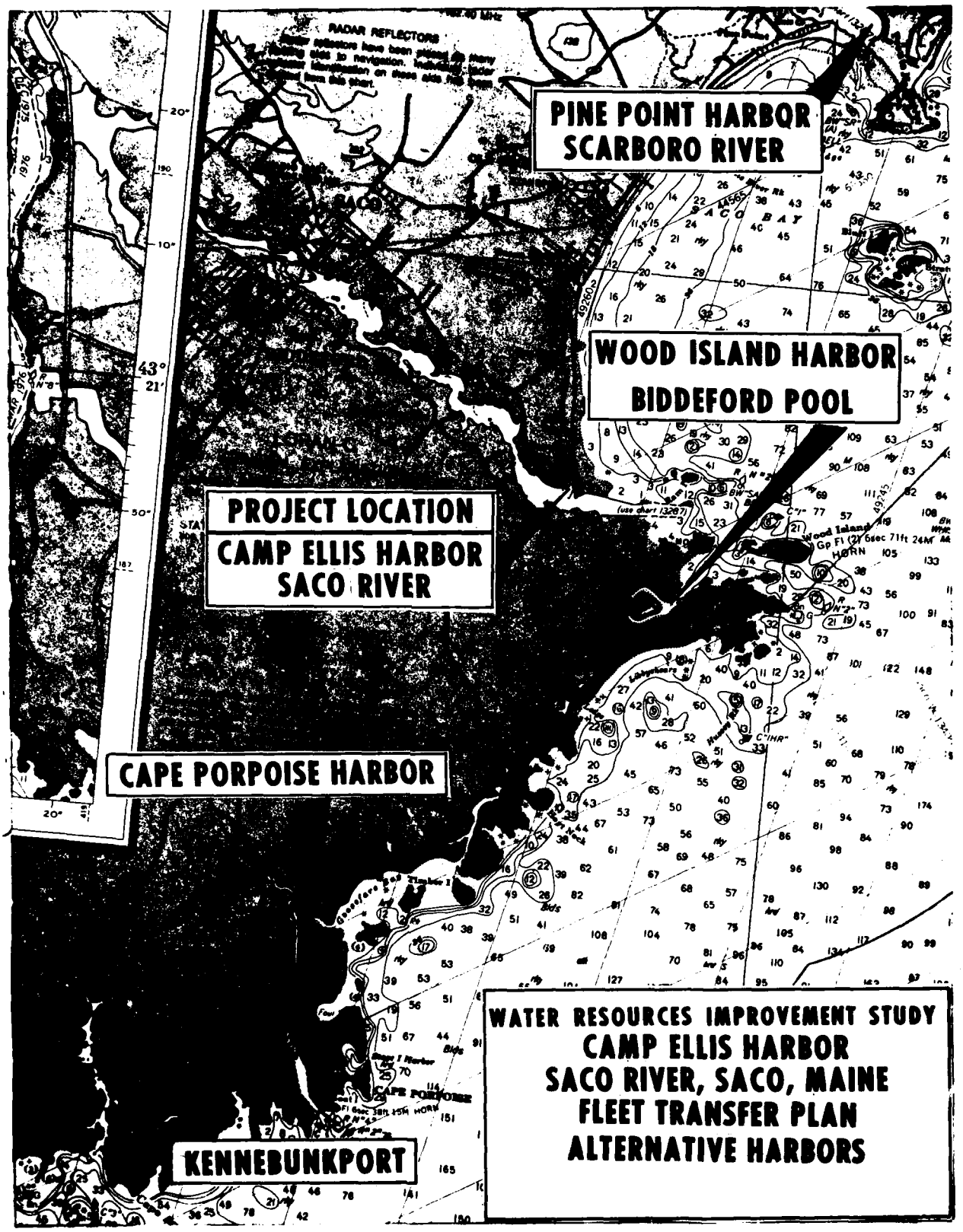
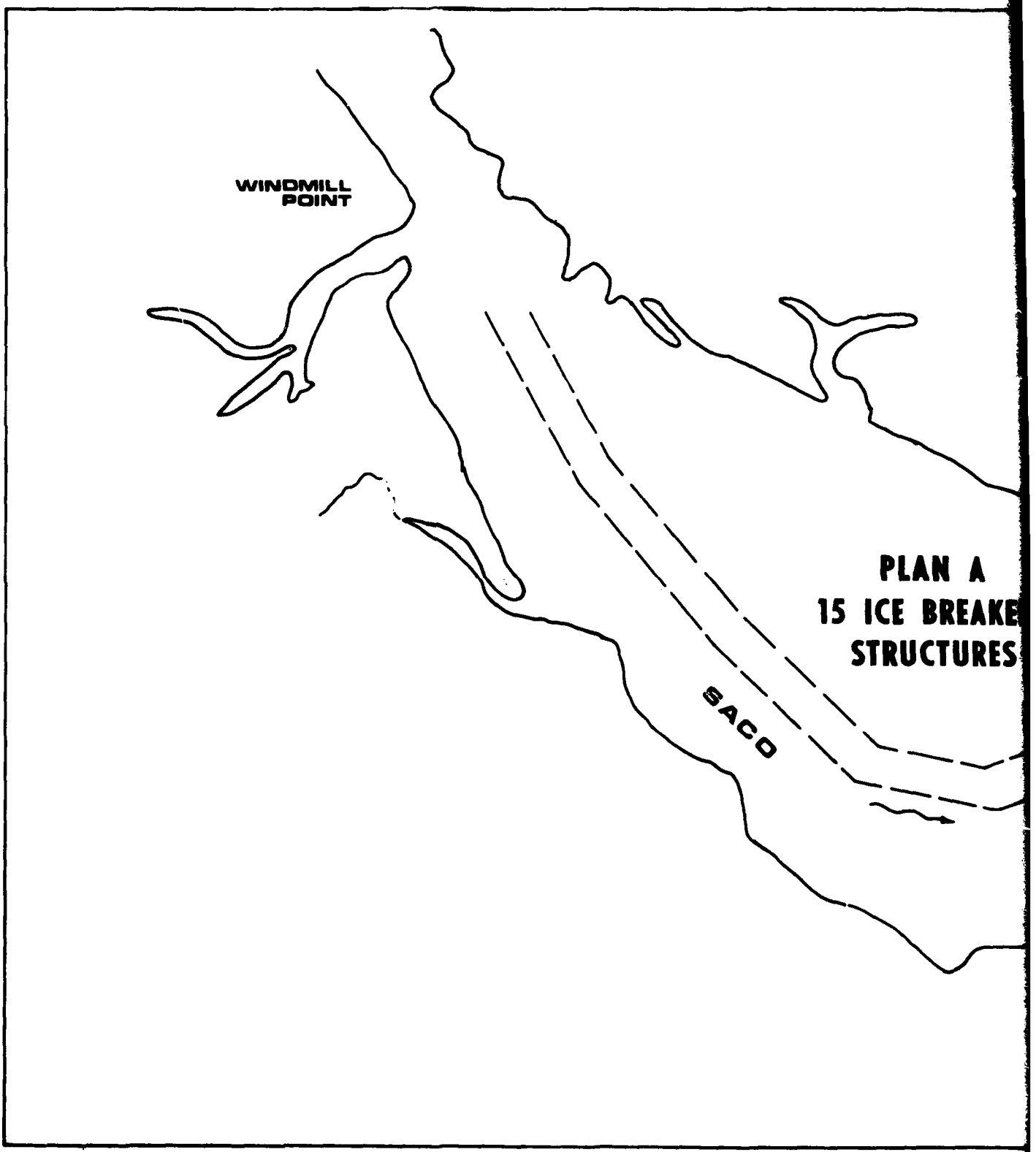
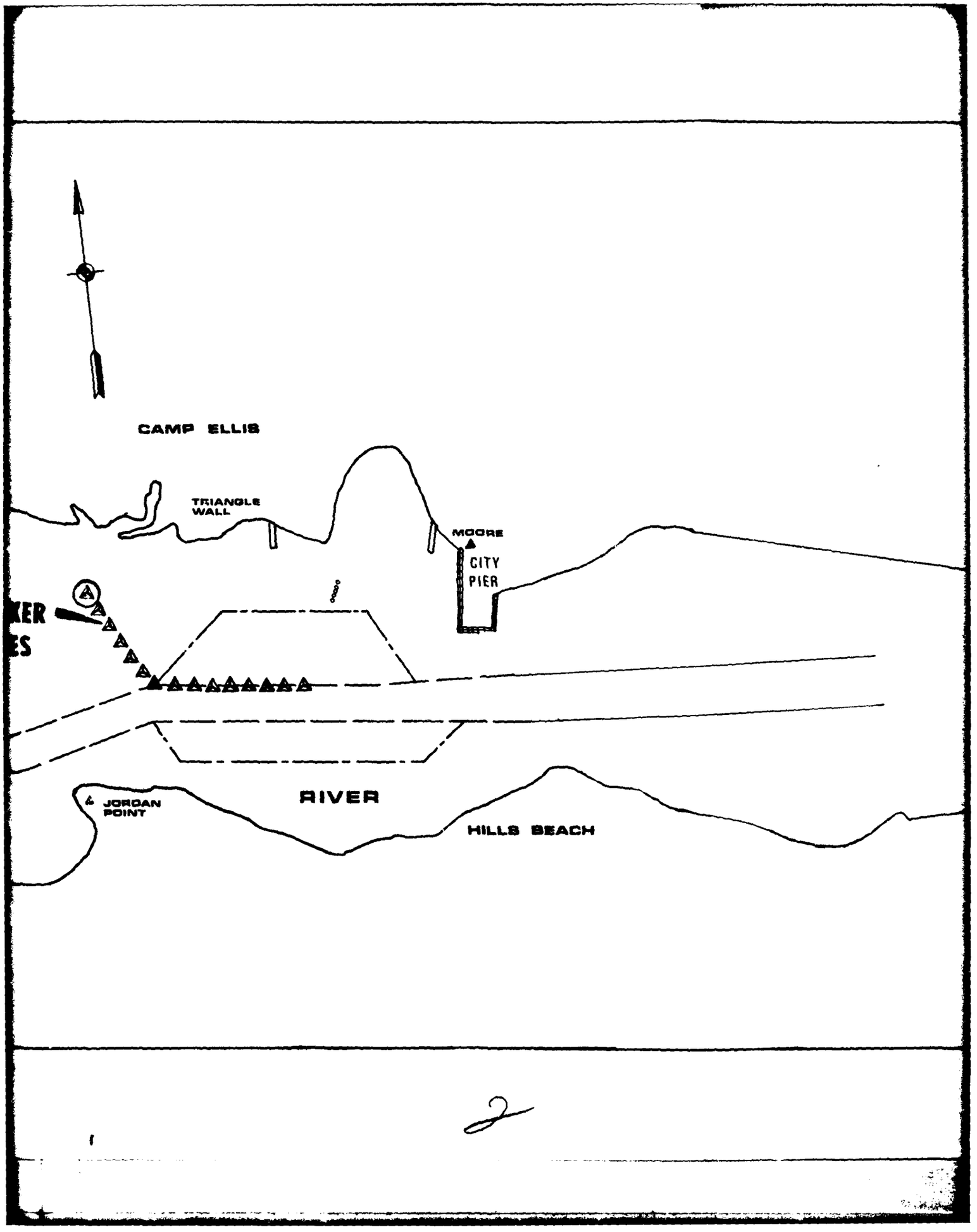
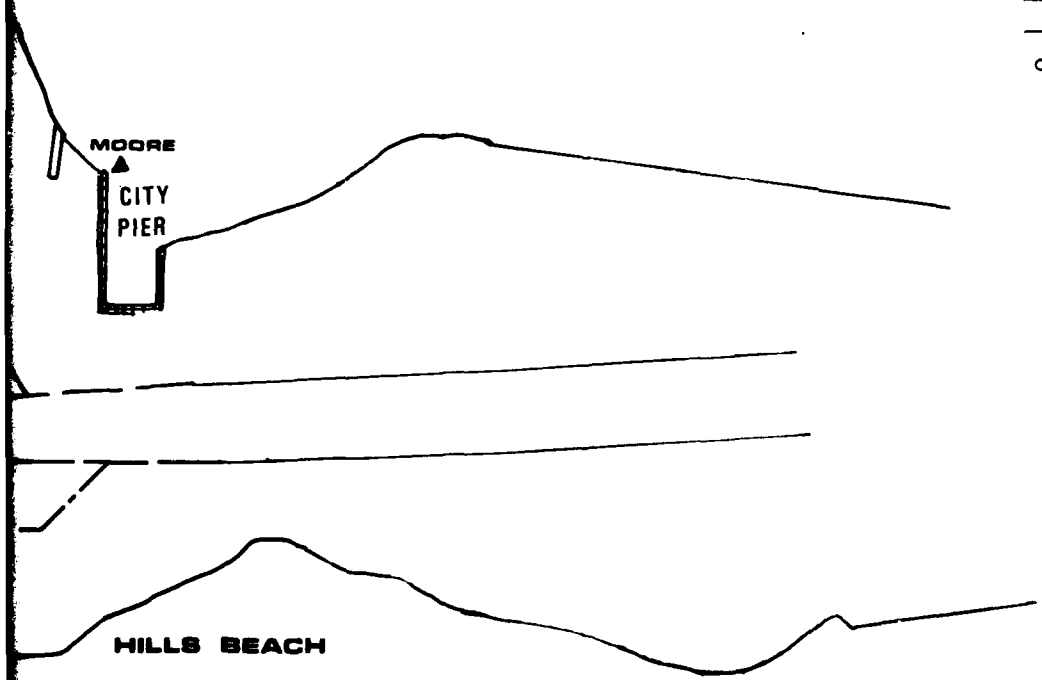

PINE POINT HARBOR
SCARBORO RIVER
WOOD ISLAND HARBOR
BIDDEFORD POOL
PROJECT LOCATION
CAMP ELLIS HARBOR
SACO RIVER
CAPE PORPOISE HARBOR
KENNEBUNKPORT
WATER RESOURCES IMPROVEMENT STUDY
CAMP ELLIS HARBOR
SACO RIVER, SACO, MAINE
FLEET TRANSFER PLAN
ALTERNATIVE HARBORS

FIGURE 2-1


WINDMILL
POINT
PLAN A
15 ICE BREAKE
STRUCTURES
SACO


CAMP ELLIS
TRIANGLE WALL
MOORE
CITY PIER
JORDAN POINT
RIVER
HILLS BEACH

CAMP ELLIS HARBOR
WATER RESOURCES STUDY
SACO RIVER, SACO MAINE
"PLAN A"



LEGEND

- EXISTING SHORELINE
- EXISTING CHANNEL
- EXISTING ANCHORAGE
- EXISTING PILES
- ICE BREAKER STRUCTURE
- OSPREY NESTING PLATFORM

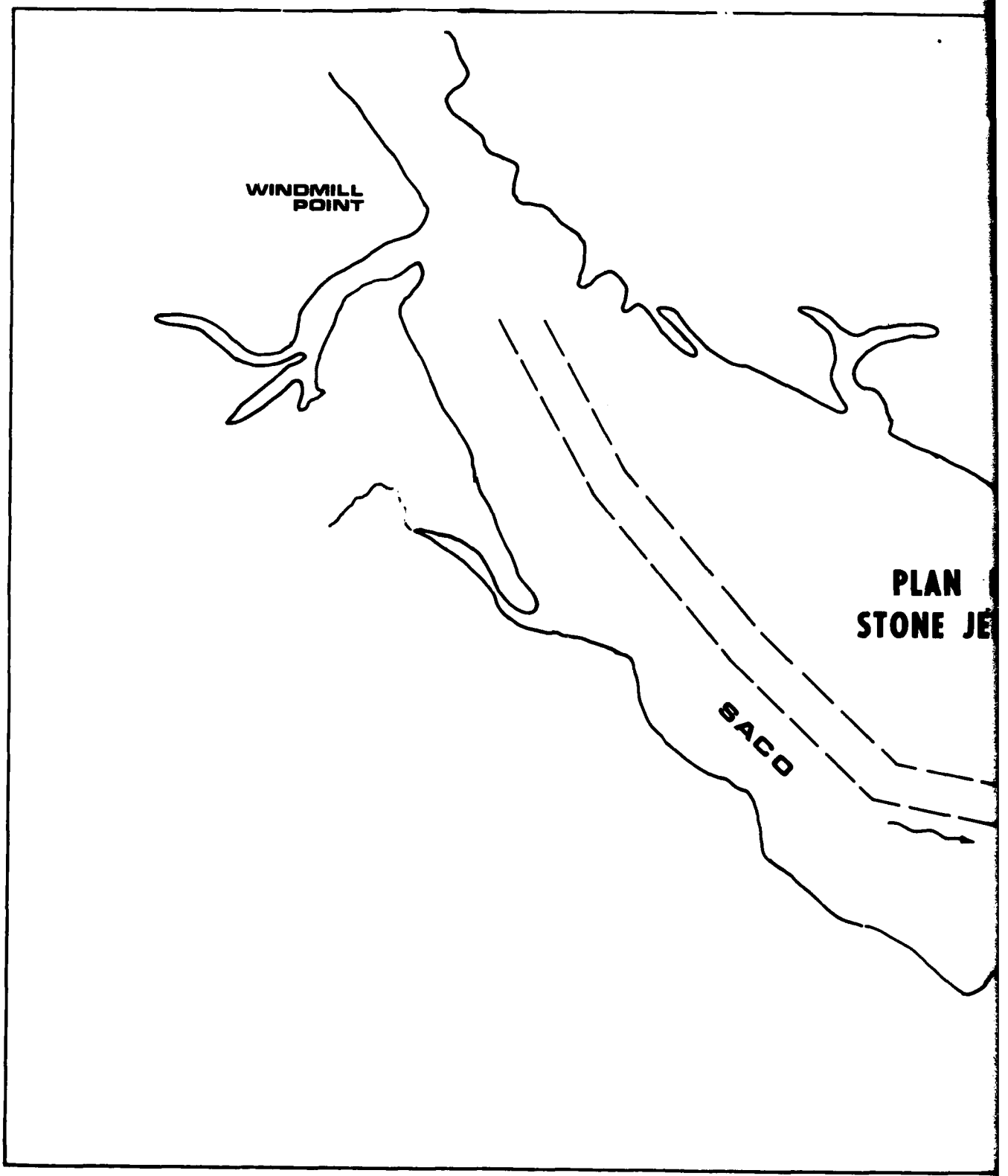
400 200 0 400 800

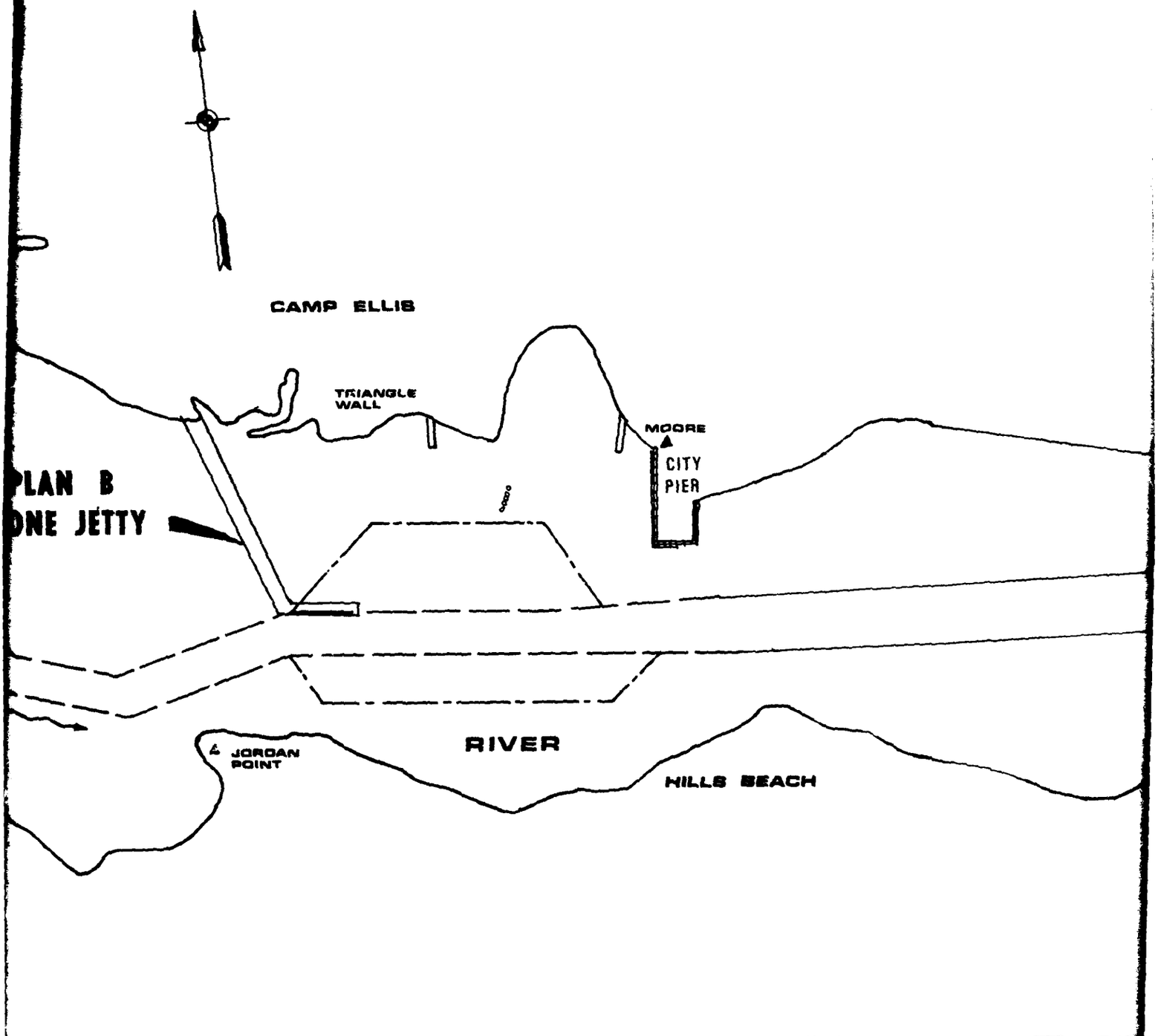
SCALE IN FEET

U.S. ARMY ENGINEER DIVISION
NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

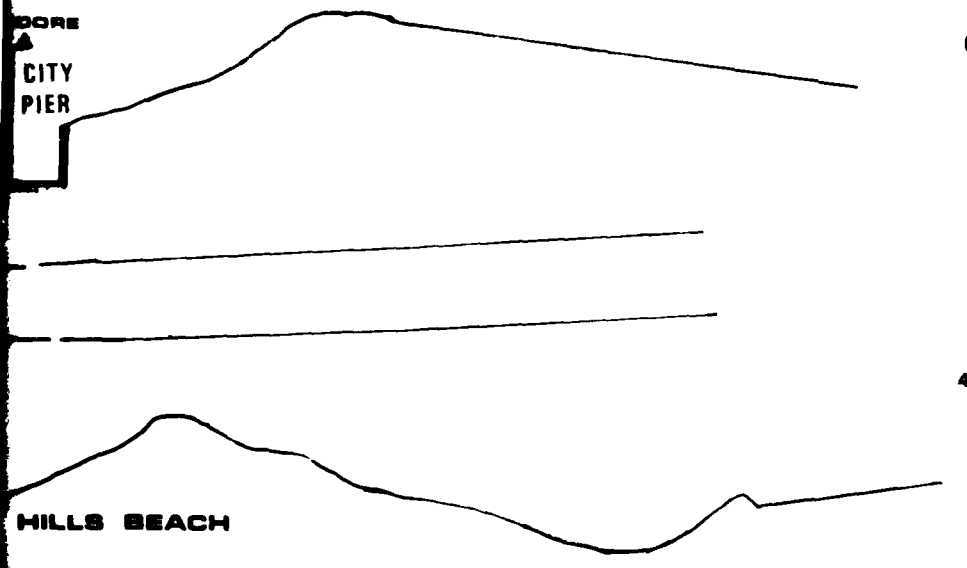
FIGURE 2-2

2 1 3


WINDMILL
POINT
PLAN
STONE JE
SACO


CAMP ELLIS
TRIANGLE WALL
MOORE
CITY PIER
PLAN B
ONE JETTY
RIVER
JORDAN POINT
HILLS BEACH

CAMP ELLIS HARBOR
WATER RESOURCES STUDY
SACO RIVER, SACO MAINE
"PLAN B"



LEGEND

- EXISTING SHORELINE
- EXISTING CHANNEL
- EXISTING ANCHORAGE
- EXISTING PILES
- ICE BREAKER STRUCTURE
- OSPREY NESTING PLATFORM

400 200 0 400 800

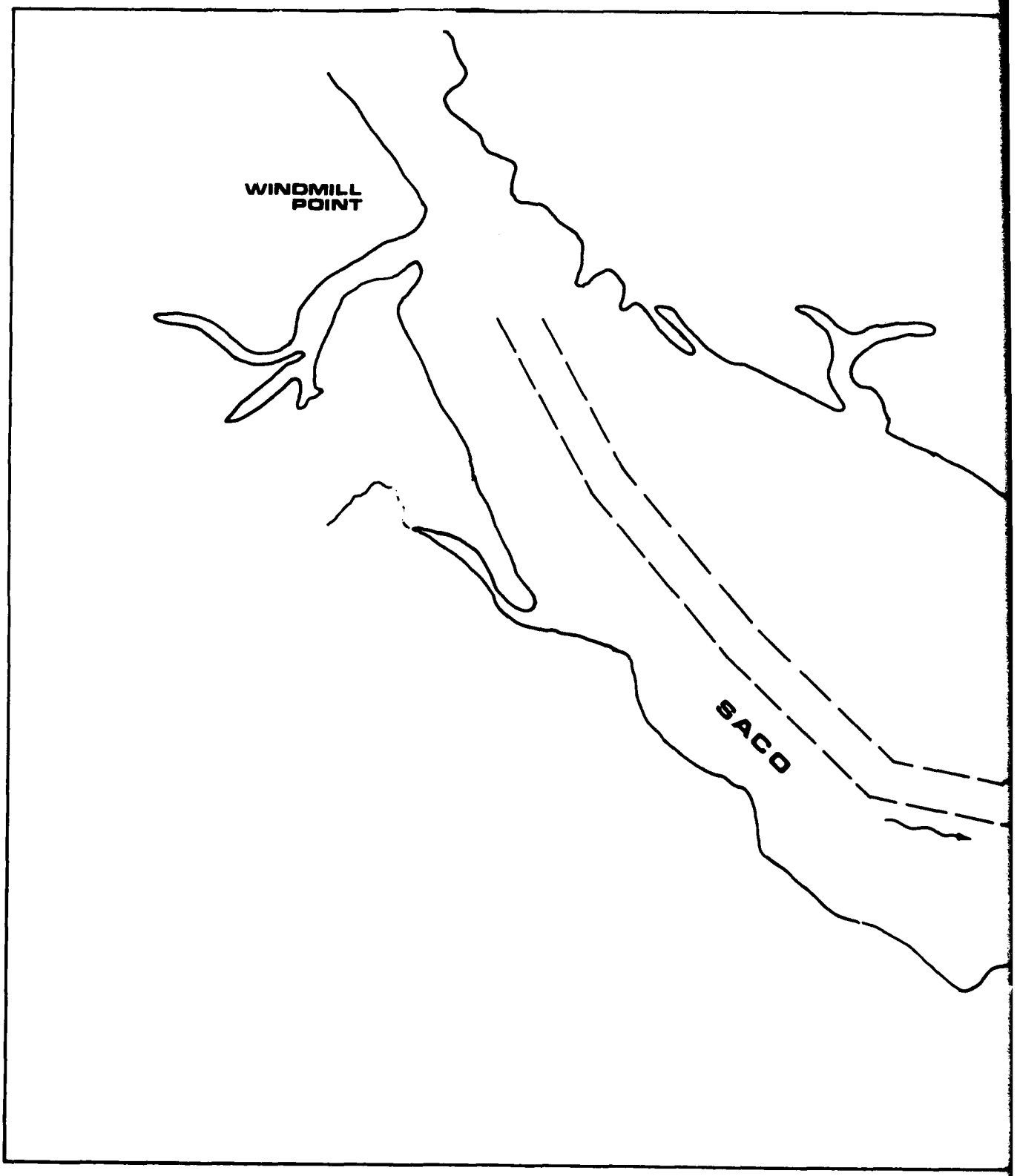
SCALE IN FEET

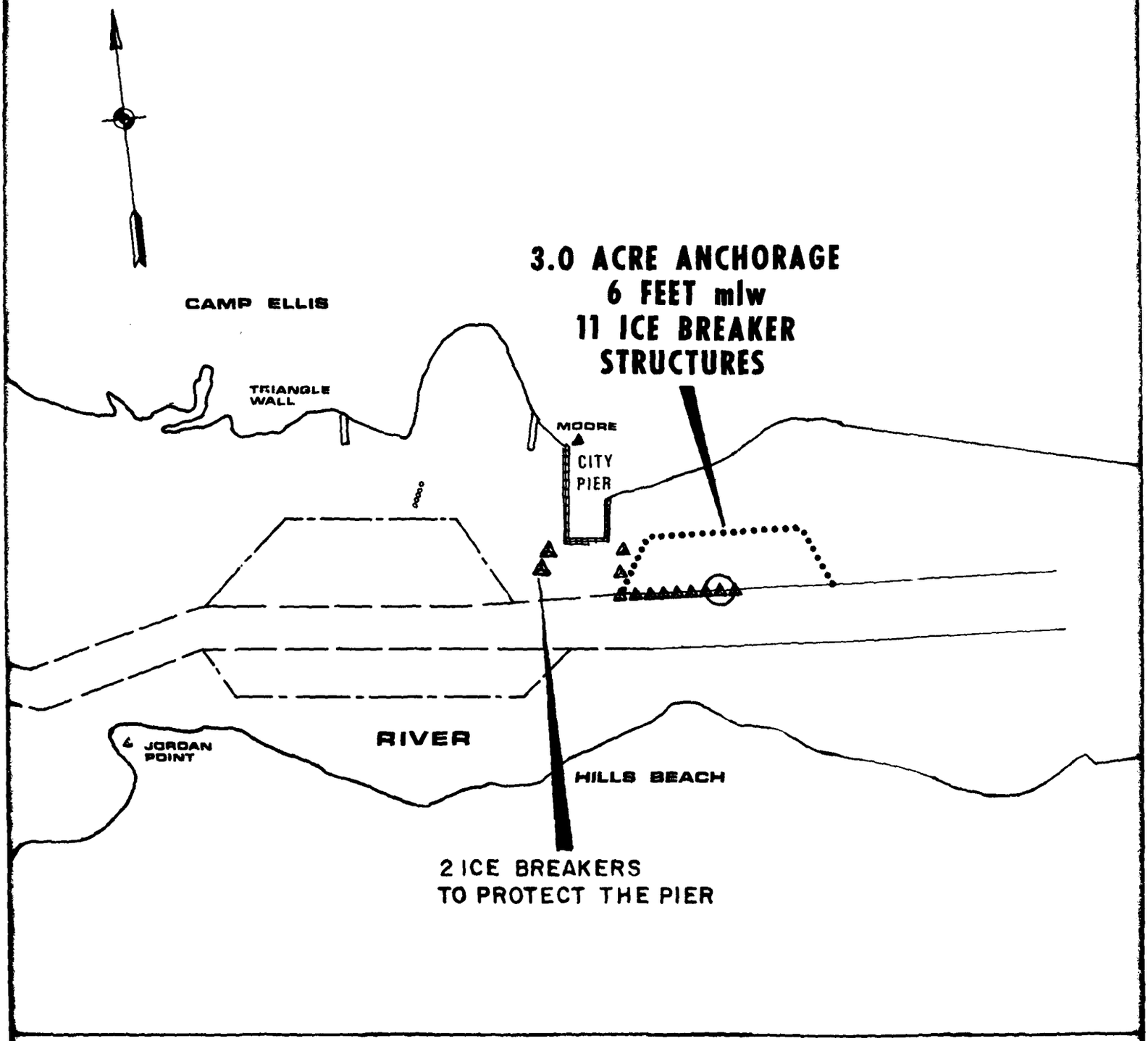
U.S. ARMY ENGINEER DIVISION
NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

FIGURE 2-3

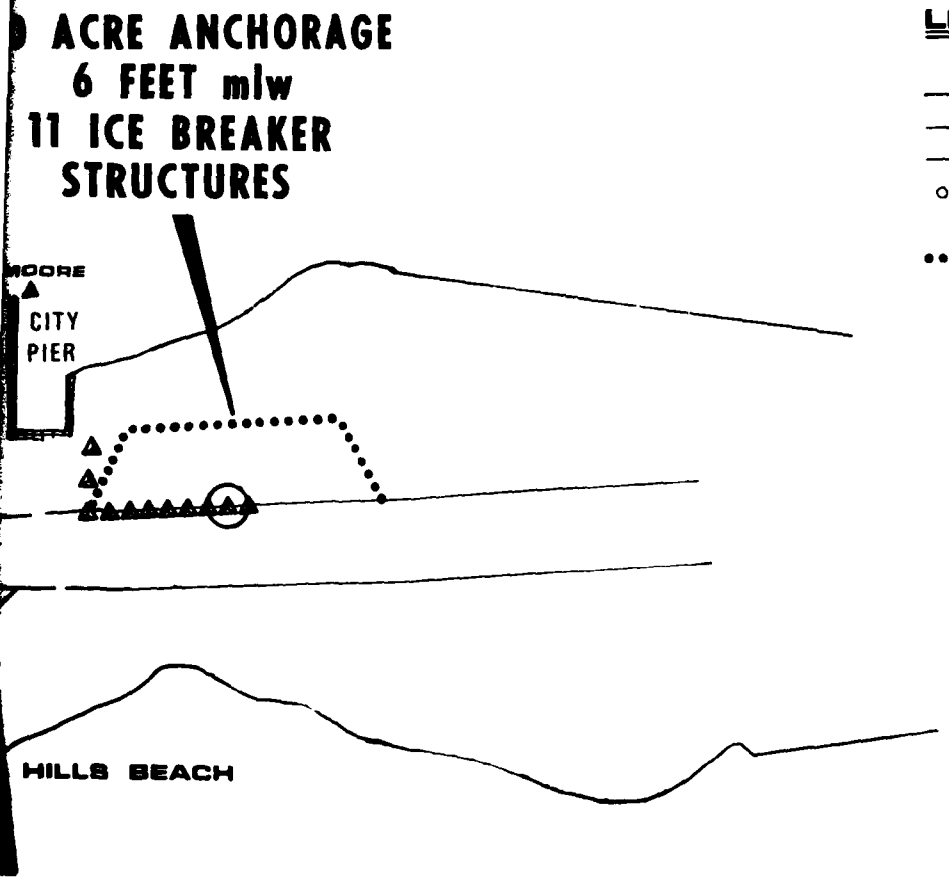
2 3

1


WINDMILL
POINT
SACO


3.0 ACRE ANCHORAGE
6 FEET mlw
11 ICE BREAKER
STRUCTURES
CAMP ELLIS
TRIANGLE
WALL
MOORE
CITY
PIER
RIVER
JORDAN
POINT
HILLS BEACH
2 ICE BREAKERS
TO PROTECT THE PIER

CAMP ELLIS HARBOR
WATER RESOURCES STUDY
SACO RIVER, SACO MAINE
"PLAN C"



LEGEND

- EXISTING SHORELINE
- EXISTING CHANNEL
- EXISTING ANCHORAGE
- EXISTING PILES
- ICE BREAKER STRUCTURE
- ALTERNATIVE ANCHORAGE
- OSPREY NESTING PLATFORM

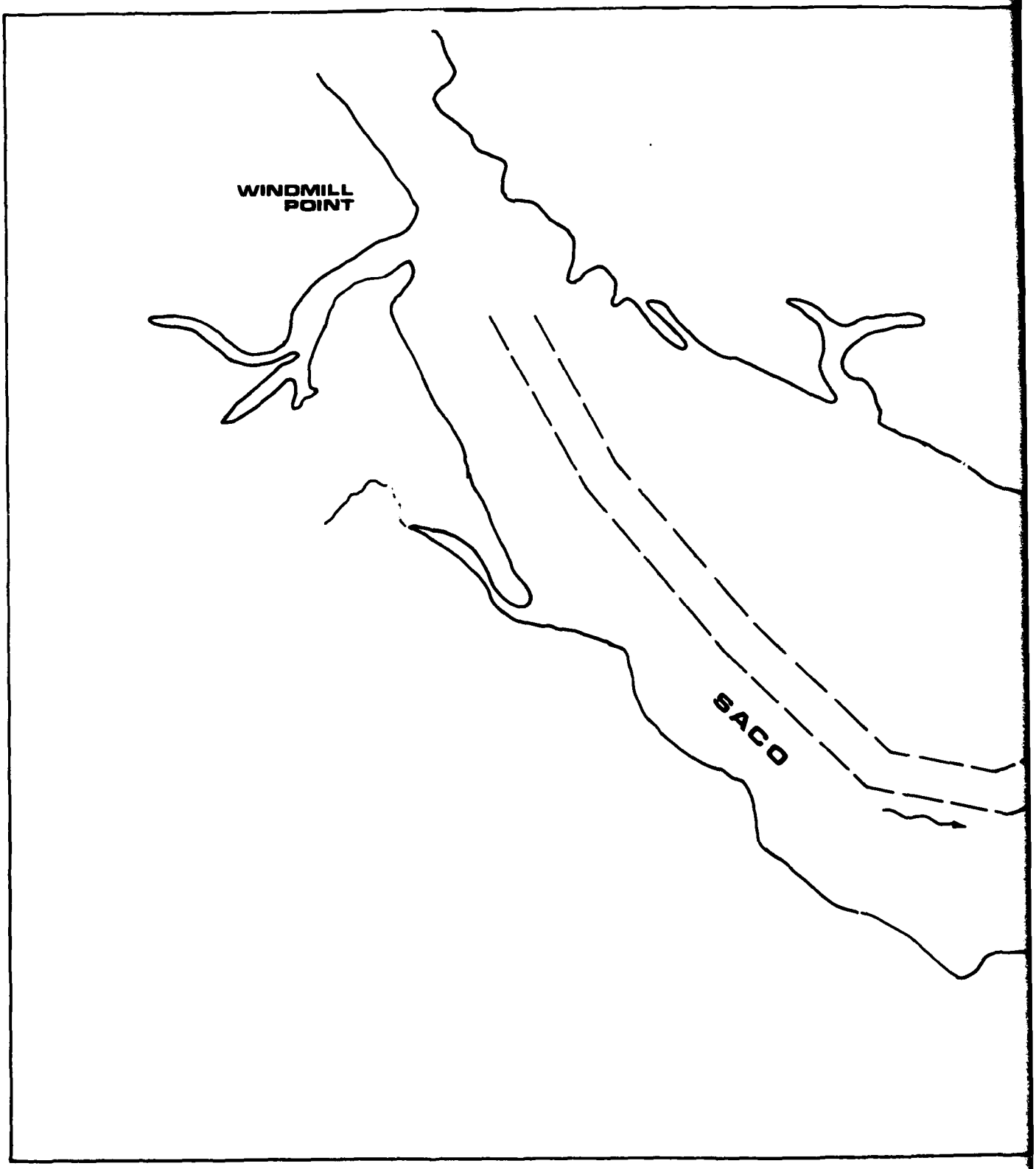
400 200 0 400 800

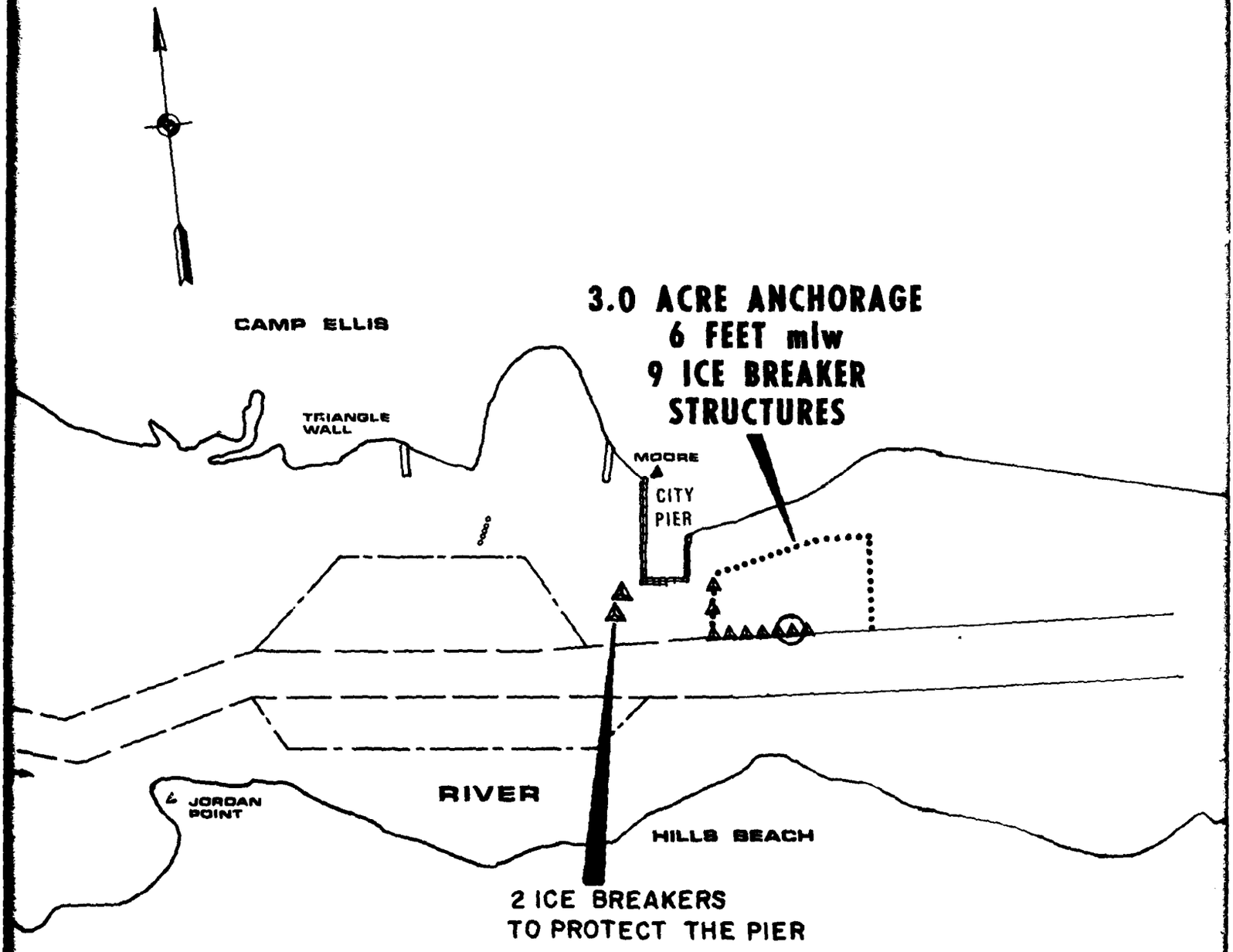
SCALE IN FEET

U.S. ARMY ENGINEER DIVISION
NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

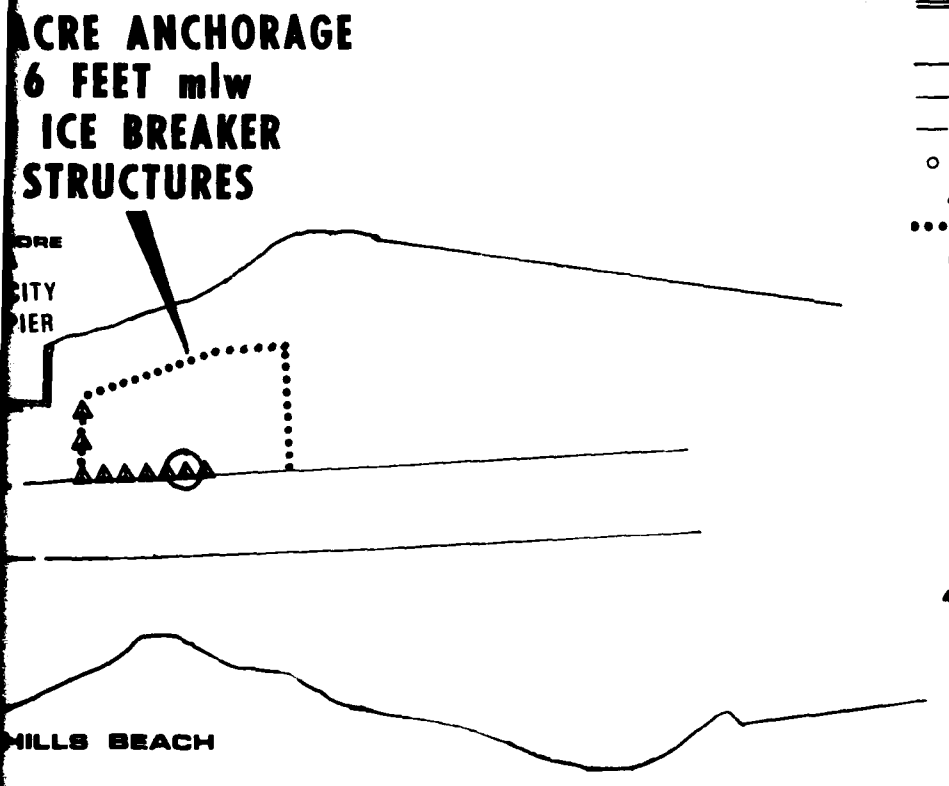
FIGURE 2-4

2 1 3


WINDMILL
POINT
SACO


3.0 ACRE ANCHORAGE
6 FEET mlw
9 ICE BREAKER
STRUCTURES
CAMP ELLIS
TRIANGLE
WALL
MOORE
CITY
PIER
RIVER
JORDAN
POINT
HILLS BEACH
2 ICE BREAKERS
TO PROTECT THE PIER

CAMP ELLIS HARBOR
WATER RESOURCES STUDY
SACO RIVER, SACO MAINE
"PLAN D"



LEGEND

- EXISTING SHORELINE
- EXISTING CHANNEL
- EXISTING ANCHORAGE
- EXISTING PILES
- ICE BREAKER STRUCTURE
- ALTERNATIVE ANCHORAGE
- OSPREY NESTING PLATFORM

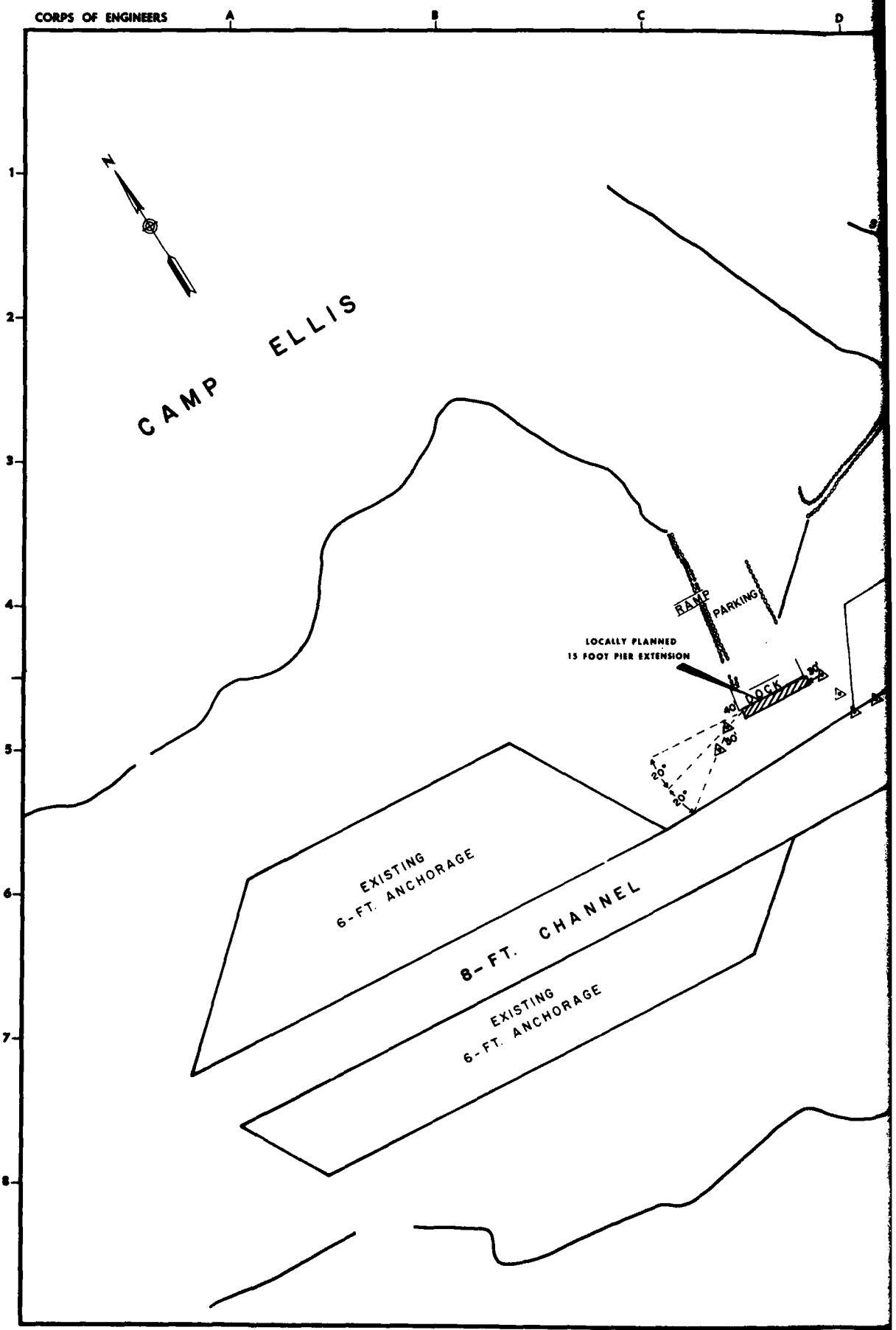
400 200 0 400 800

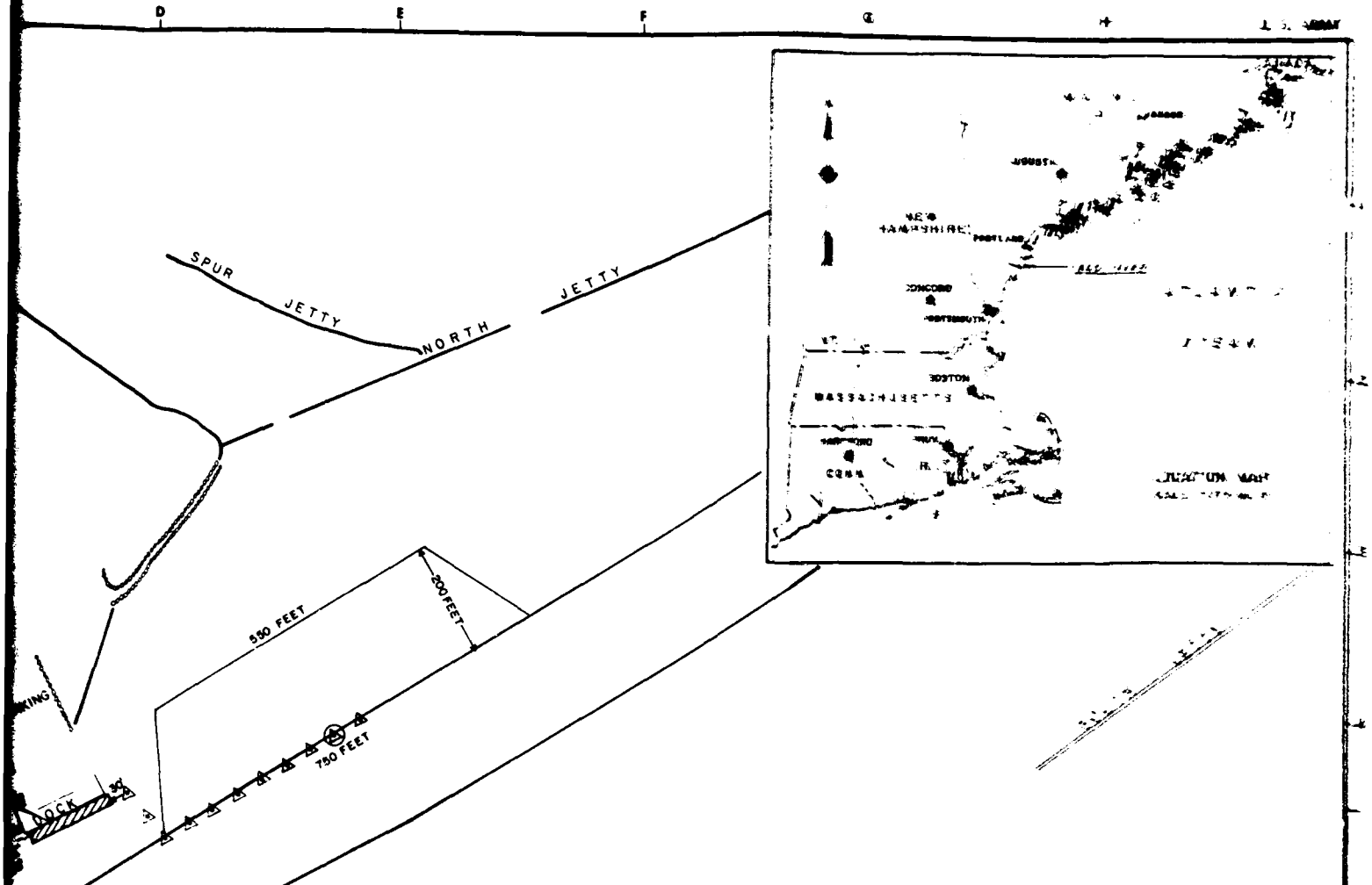
SCALE IN FEET

U.S. ARMY ENGINEER DIVISION
NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

FIGURE 2-5

2 1 3


CORPS OF ENGINEERS
A
B
C
D
1
2
3
4
5
6
7
8
N
CAMP ELLIS
RAMP
PARKING
LOCALLY PLANNED
15 FOOT PIER EXTENSION
DOCK
40'
30'
20°
20°
EXISTING
6-FT. ANCHORAGE
8-FT. CHANNEL
EXISTING
6-FT. ANCHORAGE



RECOMMENDED PLAN

3 ACRE ANCHORAGE
6 FEET MLW
11 ICE BREAKER PILINGS
TO PROTECT ANCHORAGE
2 ICE BREAKER PILINGS
TO PROTECT THE PIER
1 OSPREY NESTING PLATFORM
(mounted on 25 foot pole atop ice breaker)

NOTE ALL ICE BREAKER PILINGS ARE 2 FOOT DIAMETER STEEL PILES . . AND SPACED 50 FEET APART UNLESS OTHERWISE NOTED

GRAPHIC SCALES

1"=37.5mi 25 0 25 50 75mi

1"=100 100' 0 100' 200'

SAFETY PAYS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WATER RESOURCES IMPROVEMENT STUDY
CAMP ELLIS HARBOR
SACO RIVER, SACO, MAINE
RECOMMENDED PLAN

SCALE

SPEC. NO. DWG NO.

FIGURE 2-8

CAMP ELLIS HARBOR

SACO RIVER

SACO, MAINE

DETAILED PROJECT REPORT

PUBLIC VIEWS AND RESPONSES

APPENDIX 3

PREPARED BY:

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD, WALTHAM, MASSACHUSETTS 02254

TABLE OF CONTENTS

SECTION C

COORDINATION ACTIVITIES

- Federal Agencies
- State Agencies
- Local Government Agencies
- Elected Officials
- Individuals

PUBLIC VIEWS AND RESPONSES

SECTION A

PUBLIC INVOLVEMENT PROGRAM

Views of Government agencies were obtained through initial contacts by telephone, written correspondence and meetings. Meetings were held with Federal, State, and local officials, private interests and concerned citizens to ascertain their views on the proposed improvement project and enlist their aid in determining community needs and trends, and developing baseline studies. The following is a summary of the major comments received during the coordination phase.

Public Meeting

On 19 September 1979 at 7:30 p.m. a public meeting on the Navigation Improvement Project for Camp Ellis Harbor, Saco, Maine was held at City Hall before Colonel William E. Hodgson, Jr., Acting Division Engineer. As a result of comments received at that meeting, the proposed plan of improvement was reevaluated and then modified to better address the needs of the community. The proposed plan of improvement contained in this document is the result of the reevaluation of the initial proposal. Copies of the minutes of the public meeting may be obtained from the New England Division, Corps of Engineers, 424 Trapelo Road, Waltham, MA 02254.

Federal Agencies

US Department of the Interior, Fish and Wildlife Service

Identified an opportunity for potential enhancement of the environment and wildlife through the provision of an osprey nesting platform which it suggested could be affixed to the top of an icebreaker structure. Stated that the loss of benthic habitat due to icebreaker emplacement would be more than offset by the area for fixed habitation provided by the intertidal and subtidal portions of the structures.

US Department of the Army, Cold Regions Research and Engineering Laboratory.

After investigation of the site and performance of detailed ice engineering investigations, recommended analysis of alternatives for providing an anchorage downstream of the city pier and reduction of the spacing between piles to 50 feet.

State Agencies

Department of Marine Resources

Stated that icebreaker emplacement should have only minimal effects on marine and estuarine resources in the lower Saco River.

Department of Transportation

Expressed support for the Federal navigation improvement project and urged that consideration be given to the concerns of local fishermen as to the location of the icebreaker structures.

Department of Environmental Protection

Receipt of state permits for alteration of coastal wetlands and wastewater discharge will suffice for concurrence of project compliance with Maine's approved Coastal Zone Plan.

Local Government Agencies

City of Saco

Formally requested a Federal small navigation improvement study of the feasibility of icebreakers for the protection of the winter fleet in a letter dated 11 September 1974.

Concurred with the findings of the Reconnaissance Report and requested that the study proceed to the 2nd phase Detailed Project Report in a letter dated 6 July 1976. Stated that the city of Saco would meet the requirements of local cooperation as outlined in the Reconnaissance Report.

Outlined the planned improvements to the city pier and dock. Stated that the proposed disposal of spoils on Camp Ellis Beach was acceptable to the city in an 8 March 1981 letter.

SECTION B

COPIES OF CORRESPONDENCE

CITY OF SACO
MAINE

BERTON K. BRALEY
MAYOR
JOHN S. DEXTER, JR.
CITY ADMINISTRATOR

September 11, 1974

Division Engineer
New England Division
Corps of Engineers
Department of the Army
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Sir:

This letter is to formally reques a Federal navigation improvement under Section 107 of the River and Harbor Act inacted July 14, 1960 and amended in 1965 and 1970. Specifically, the letter is to request the Army Corps of Engineers to review the installation of ice breakers in the Saco River project area so that our commercial fishing fleet will be able to use the previously constructed Corps navigation project for mooring their vessels on a year-round basis.

Your cooperation with regard to investigating the feasibility of a Section 107 project for the construction of these ice breakers will be very much appreciated. My review of your requirements for such a project appears to indicate that the City would be eligible for your assistance. We are also prepared to give you local assistance in gathering information once we receive communication from you indicating exactly what information you would like.

Your assistance in this matter will be very much appreciated.

Sincerely,

John S. Dexter, Jr.
City Administrator

JSD/mj

STATE OF MAINE
DEPARTMENT OF MARINE RESOURCES
STATE HOUSE
AUGUSTA, MAINE 04333

June 16, 1976

Ralph T. Garver, Colonel
Department of the Army
New England Division, Corps of Eng.
424 Trapelo Road
Waltham, Massachusetts 02154

ATTN: NEDPL-C

Dear Sir:

The draft reconnaissance report for navigation improvements of the Saco River (Camp Ellis Harbor) has been received by this agency. This proposal involves the placement of seven corrosion resistant steel pyramid ice breakers in the Saco River at Camp Ellis.

This project should have minimal effects on marine and estuarine resources in the lower Saco River. Therefore the Department of Marine Resources has no objections to this proposed improvement.

Sincerely,

Vinal O. Look

VINAL O. LOOK
Commissioner

VOL/mw
cc: Gary Stackhouse, Fish & Wildlife Service

L M. ZAITLIN
V OR
34-4831

CITY OF SACO

JOHN S. DEXTER, JR
CITY ADMINISTRATOR
282-4191

July 6, 1976

Ralph T. Garver
Colonel, Corps of Engineers
Acting Division Engineer
Department of the Army
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Garver:

This letter is written in response to your letter of June 8, 1976 in which you inform us of your finding that the proposed icebreakers at Camp Ellis Harbor in the Saco River are cost effective.

After careful review, I can see no reason why the City cannot meet the required local cooperation conditions. On behalf of the City of Saco, I, therefore, inform you of our willingness to accept the prior-to-project construction and ask that you move forward with your detailed study.

We are most grateful for your cooperation.

Sincerely,

John S. Dexter, Jr.
City Administrator

JSD/mj

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
P. O. BOX 1518
CONCORD, NEW HAMPSHIRE 03301

January 16, 1979

Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Sir:

This is our Conservation and Development Report concerning a proposed plan of the U.S. Army Corps of Engineers for navigation improvements in the Saco River at Camp Ellis, York County, Maine. This report is authorized by the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and was prepared in coordination with the Maine Department of Inland Fisheries and Wildlife and the Department of Marine Resources.

The project site is the anchorage area located in the Saco River between Camp Ellis and Jordan Point and just inside the jetties at the mouth of the river about six miles downstream from Saco and Biddeford. The anchorage has been dredged to 6 feet below mean low water and it has a total area of 10.5 acres. It is divided into north and south sections by the 8-foot deep navigation channel. The study is authorized by Section 107 of the 1969 Rivers and Harbors Act.

The proposed project consists of the installation of clusters of wood pilings at 200-foot intervals around the perimeter of the anchorage. The pilings would extend about 6 feet above mean high water and be connected by log booms. The purpose of the project is to protect fishing vessels from damage by sheet ice during late winter. The booms would be removed during the ice-free season.

The Saco River estuary extending from the jetties upstream to the dams at Saco and Biddeford is relatively unpolluted and supports migratory waterfowl, muskrat, mink, other small mammals, and fish species such as alewives, smelt, striped bass, and Atlantic salmon as described in our report dated October 7, 1977.[1] In addition, sand eels, mackerel, menhaden, and sand shrimp also are found in the estuary. It is expected that the project, as planned, will have little adverse impact upon fish and wildlife resources during the project life. Pile driving will cause a

[1]USFWS, October 7, 1977. Post Authorization Report of the U.S. Fish and Wildlife Service on a Plan Being Developed for Maintenance Dredging of the Saco River by the U.S. Army Corps of Engineers.

temporary disturbance in the anchorage area and a small amount of benthic habitat will be lost. This loss is expected to be more than offset by plant and animal communities that will become attached to intertidal and subtidal portions of the pilings.

There is an opportunity for potential enhancement of wildlife that should be considered. Construction of two to four artificial nesting platforms for osprey should be incorporated into project plans. A piling of at least 8 inches in diameter should be adequate to support each platform and they could be set in place as one of the pilings in the clusters.

There is no known osprey nesting in the estuary, but osprey are occasionally seen at Biddeford Pool. The estuary area appears to be adequately supplied with food resources for osprey during the nesting season. Their principal prey is fish and during the nesting period alewives seem to be a preferred species. Human activity in the anchorage area would be a disturbing element but osprey seem to be somewhat tolerant to such disturbances. Pleasure boating activity would normally peak during the latter part of the nesting cycle. Disturbance would be minimized by placing the platforms on the south and west sections of the anchorage, placing the platforms about 25 feet above mean high water, and not less than 200 feet apart.

Osprey nest in early spring. Egg laying occurs about the first of May. Hatching occurs between May 25 and June 1 and the young leave the nest about 60 days later or in mid-July.

There are no known artificial nesting platforms in Maine but osprey do nest on crossarms of transmission line poles and on the metal superstructure of navigation bucys.

Osprey are not particularly fussy about nesting structures, so a sophisticated platform design is not necessary. The attached sketch provides an idea of a possible design showing the basic 4-foot by 4-foot dimensions. The side rails need to be no more than 2 or 3 inches above the surface of the platform, and the corner posts can extend 12 to 18 inches above it. The use of saplings for the latticed platform would lend a natural look to the platform but is not critical. Two-inch by four-inch construction lumber can be used. A durable wood, such as cedar, should be preferred.

The function of the side rails and corner posts is to help hold the stick nest in place. The lattice work is necessary to provide drainage. Placing of a few loose sticks in the nest when it is installed is often done and seems to attract the birds.

The platform needs to be sturdy because osprey often use the same nest year after year and keep adding nesting materials. The weight of the nest can then be as much as a half ton or more.

A number of platforms constructed of used industrial pallets have been erected at various locations along the East Coast and some of these have been used for nesting. Pallets seem to be the most used structural material for platforms and are the least expensive.

There is no guarantee that osprey will use the platforms but it is possible. If the platforms are used, there is no way to evaluate the monetary value of contributing to the population of this interesting raptor and of helping to extend its nesting range into a new area. Nesting birds also would have considerable aesthetic value to many people. Intangible benefits resulting from construction and possible use should more than offset the small cost of adding them to the project.

We recommend that installation of two to four osprey nesting platforms be incorporated into the project. We will be glad to assist you in any way possible and we will plan to review and comment on the detailed plan for the platforms and their specific location.

Sincerely yours,

Gordon E. Beckett
Supervisor

Attachment

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
TRANSPORTATION BUILDING AUGUSTA, MAINE 04333

ROGER L. MALLAR
Commissioner

September 14, 1979

Colonel William E. Hodgson, Jr.
Division Engineer
Department of the Army
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Hodgson:

This Statement is in response to your announcement of a public meeting for a Navigation Improvement Project, for the Saco River, Camp Ellis Harbor, Saco, Maine. Meeting to be held 19 September 1979, 7:30 PM in City Hall, Saco, Maine.

S T A T E M E N T

The Maine Department of Transportation supports this Navigation Improvement Project.

The City of Saco has requested State participation in improvement to the public commercial pier at Camp Ellis, and this project would provide additional protection for this facility as well as protection for the commercial fishing vessels in this harbor.

The local harbor master, Mr. Donald R. Abbott, has indicated that it would be beneficial to consult the local fishermen on the location of the ice breaker structures.

The Maine Department of Transportation urges that consideration be given to the concerns of the local fishermen as to the location of the structures to the extent that this can be done and still preserve the integrity of this project. It is further urged that the project receive prompt final approval and that it be scheduled for construction as early as possible.

Very truly yours,

Daniel Webster, Jr.
Deputy Commissioner
Planning and Administration

DW:JC:plb
cc: Mr. Donald Abbott
Representative McSweeney

DEPARTMENT OF THE ARMY
COLD REGIONS RESEARCH AND ENGINEERING LABORATORY, CORPS OF ENGINEERS
HANOVER, NEW HAMPSHIRE 03755

CRREL-EI

4 November 1980

Mr. Bob MacDonald
NEDPL-C
U.S.Army Engineer Division, New England
424 Trapelo Road
Waltham, MA 02154

Dear Bob:

Enclosed is a Memo for Record giving our opinions on the ice problems at Camp Ellis Harbor, ME. I hope this is sufficient for your needs and apologize for the delay.

Sincerely,

S L Den Hartog

1 Encl
as

STEPHEN L. DEN HARTOG
Geologist
Ice Engineering Research Branch

MEMO FOR RECORD

Camp Ellis Harbor, ME

Introduction

On 22 September 1980 Messrs DenHartog and Tantillo visited Saco Bay, Maine with Mike Misslin and Bob MacDonald of NED. We discussed the winter harbor at Camp Ellis, Maine in Saco Bay for the local fishing fleet. The main consideration was protection of the fleet from ice. Unfortunately we found no local people familiar with the ice problems. We reviewed ice data taken by the Dale E. Caruthers Company which consisted of ice formation and movement on the Saco River in the vicinity of the proposed pier improvement. Based upon this short visit and review of the NED supplied data, we feel confident in our recommendation for ice protection at the winter docking facility.

Site Description and Problem

Saco Bay is located about 20 miles south of Portland, Maine at the mouth of the Saco River. The Bay opens to the east into the Atlantic Ocean. It is well protected by a breakwater which extends almost a mile out into the Atlantic.

The fishing fleet out of Saco has been damaged by winter ice and there is no safe winter location for them to moor. This problem has forced many fishermen to stop fishing or find alternate anchorage sites for the winter, causing financial losses to them and, subsequently, the community.

The fleet has been subjected to ice floes up to 200 ft in diameter. The proposed upstream pile structure would give partial protection to the boats but will pass smaller, broken pieces as well as the thin, sharp, fresh water ice that cuts and erodes hull plating at the water line. However, there is a possibility that any ice caught between the piles and the pier would stay there and not be

easily flushed out by tide or boat movement. The downstream shadow of the pier would be the safest location for the winter fleet. Three or four pile clusters in line with the channel and downstream of the present pier at a spacing of no more than 50 ft would keep the larger floes out of the proposed downstream anchorage.

Thomas J Tantillo

THOMAS J. TANTILLO
Mechanical Engineer
Ice Engineering Research Branch

S. L. Den Hartog

STEPHEN L. DEN HARTOG
Geologist
Ice Engineering Research Branch

CITY OF SACO

OFFICE OF THE CITY ADMINISTRATOR
Saco City Hall
300 Main Street, Saco, Maine 04072
Telephone: (207) 282-4191

March 3, 1981

Michael D. Misslin, Civil Engineer
Department of The Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mike:

I appreciate your attending the meeting at Camp Ellis on February 19th. I feel that your input, as well as the Maine Department of Transportation, went a long way toward making the fishermen at Camp Ellis feel that all levels of government were attempting to solve their problem.

In regard to our conversation on the 19th., this letter should confirm the fact that this City is not now, or in the future, planning to extend the pier by adding a wing which would jut into the down stream portion of the River. Your plans for the ice breaker and dredging work should include the assumption that the pier will be extended by 15' at some future date by simply extending it straight out into the River. It is unlikely that this extension will be accomplished within the next five years. This should also reconfirm the desires of the fishermen for you to design your ice breakers down stream of the pier in its shadow, at an angle.

Since this pier project is to stabilize and strengthen the existing pier and its rip-rap and not its extension, this project should be considered as a maintenence project and not new construction. This should alleviate the need for many of the required permits that a construction project would necessitate.

In regard to your question as to spoilage from dredging being dumped on the side of the breakwater opposite the River, we have been in contact with most of the property owners involved and there has yet been no objection. Since many of the owners are only in residence during the summer, we will attempt to contact them all before the start of the dredging. We are also having discussions with the Army National Guard as to the spreading of the spoiled material and we would hope to have an answer from them by late May as to this request.

Please let me know as to the status of your ice breaker and dredging project and if this office can be of any further assistance to you in regard to said project.

Thank you for your cooperation in this matter.

Sincerely,

David B Wright

David B. Wight
City Administrator

DBW/jm

MARCEL G. MOREAU
P.O. BOX 81 • SOUTH BRISTOL, MAINE 04568
WORK: (207) 563-3146 HOME: (207) 644-8360

October 22, 1981

Col. William E. Hodgson, Jr.
U.S. Army Corps of Engineers
New England Division
424 Trapelo Road
Waltham, MA 02254

Dear Col. Hodgson:

I have reviewed your Draft Detailed Project Report and Environmental Assessment concerning the construction of an anchorage with protective icebreaker structures in the Saco River at Camp Ellis, Maine. I have found the report to be comprehensive, clearly presented, and accurate. The selected plan is well-conceived and sure to be a boon to the Camp Ellsi fishermen. Your staff is to be commended for a job well done.

I sincerely hope that the project can be completed before the Camp Ellis fleet is subjected to another perilous winter season.

Cordially,
Marcel Moreau
Coastal Ecologist

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Services Division
Habitat Protection Branch
7 Pleasant St.
Gloucester, Massachusetts 01930

October 27, 1981

Col. C. E. Edgar, III
Division Engineer
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, MA. 02254

Dear Colonel Edgar:

The National Marine Fisheries Service (NMFS) has reviewed the Draft Detailed Project Report and Environmental Assessment concerning the navigational improvements to the Saco River - Camp Ellis Harbor, Maine, Public Notice No. NEDPL-C, dated October 1, 1981.

The Draft Detailed Project Report outlined four plans designed to improve safety to commercial fishing vessels moored in Camp Ellis Harbor during the winter months. The primary concern was improved protection from ice damage. Plan A entailed placement of ice breaker structures, while Plan B proposed a stone jetty be placed, both upstream of the existing North Anchorage Area. Plans C and D provide for creation of a new three-acre anchorage area east of the existing city pier, and placement of ice breaker structures to protect the new anchorage. Plan D would require more dredging than Plan C because of a different anchorage area configuration.

Dredging would be either hydrualic, with disposal on Camp Ellis Beach adjacent to the dredge site, or clamshell dredging with transport and disposal at the Cape Arundel Dumpsite.

In our opinion, Plan A is the environmentally preferable option because it would cause the least impact to the marine ecosystem. The recommended plan is Plan C with hydraulic dredging and disposal on Camp Ellis Beach. While Plan A would have less environmental impact, biological communities existing in Camp Ellis Harbor are undoubtedly accustomed to a great deal of physical disturbance from storms. The predominant sediment type on the beaches was coarse sand and gravel, indicating an unstable area, exposed to high energy. Any disruptions or impacts from the proposed activities of Plan C would probably be short lived and the disturbed areas would rapidly restabilize.

While the NMFS considers Plan A to be the environmental preferable option, we find Plan C an acceptable plan for improvement of Camp Ellis Harbor. We offer no objection to the implementation of Plan C.

Any questions regarding this project should be directed to Mr. Gene Crouch (FTS 837-9317) of my staff.

Sincerely,

Ruth Rehfus

Ruth Rehfus
Branch Chief

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION I

J. F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203

October 29, 1981

Colonel William E. Hodgson, Jr.
Acting Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, MA 02254

Re: NEDPL-C
EPA #8832

Dear Colonel Hodgson:

We have reviewed the Draft Detail Project Report and Environmental Assessment concerning the advisability of providing navigational improvements in the Saco River at Camp Ellis Harbor, Maine.

This Environmental Assessment provided adequate information on project need and justification and sufficient discussion of project alternatives. We are in agreement with the dredging of the 3 acre 6 foot deep anchorage protected by ice breaker structures easterly and westerly of the existing pier.

This project appears to have minimal effects on marine and estuarine resources in the lower Saco River. Therefore, we have no objection to the project.

Questions regarding these comments should be directed to Kaye Cleghorn at 617/223-5061.

Sincerely yours,

Allen J. Ikalainen

Allen J. Ikalainen
Chief, Special Permits Section

cc: NMFS, Gloucester, MA
USFWS, Concord, NH

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
P.O. Box 1518
Concord, New Hampshire 03301

Colonel William E. Hodgson
Deputy Division Engineer
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254

Dear Colonel Hodgson:

We have reviewed the draft of your Detailed Project Report concerning your navigation study at Saco River - Camp Ellis Harbor, Saco, Maine. We are pleased that your plan includes construction of a nesting platform which can be used by Osprey. It might take several seasons before they nest, but we are hopeful that it will eventually be used by Osprey. In the meantime, we feel certain that it will be used by other seabirds. To the best of our knowledge this will be the first time that such a nesting platform has been constructed by the New England Division.

We agree that Plan A will cause the least habitat disruption, and we agree with your selection of this plan as the E. Q. Plan. As such, we would prefer it as the recommended plan for its minimal impact and because it would place the nesting platform further away from human activities at the pier - about 1600 feet com pared to about 400 feet for the recommended plan. The recommended plan (Plan C), however, will cause no significant, long-term adverse impacts. Proposed dredging to create a 3-acre anchorage area will eliminate about 0.3 acres from the intertidal zone and impact another 0.5 acres. Placing the dredged material, and spoil from future maintenance dredging, on the beach will avoid offshore disposal. Construction of the Osprey platform downstream from the pier should not significantly reduce its attractiveness for birds even though it will be located nearer to human activity at the pier. This plan would cause less adverse environmental impact than Plan D, which would require more dredging of intertidal habitat.

We are pleased to note that minimizing adverse impacts upon fish, wildlife, and marine resources is included in two of the three planning constraints. Also, inclusion of detailed data on the intertidal and benthic area to be dredged, the specific amount of benthic habitat that will be lost when the icebreakers are installed, and the area of the icebreakers that will form new surfaces for attached organisms, greatly assists in evaluating project impacts. This detailed project data also is useful in assessing the environmental impacts of the various alternate plans under consideration.

Sincerely yours,

Gordon E. Beckett

Gordon E. Beckett
Supervisor

STATE OF MAINE
Department of Environmental Protection

MAIN OFFICE: RAY BUILDING, HOSPITAL STREET, AUGUSTA
MAIL ADDRESS: State House Station 17, Augusta, 04333

JOSEPH E. BRENNAN
GOVERNOR

HENRY E. WARREN
COMMISSIONER

November 6, 1981

Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, MA

ATTENTION: Michael D. Misslin

RE: Saco River Improvements

Dear Mike:

Enclosed please find applications for Alteration of C stal Wetlands and Waste Water Discharge.

The ice breakers, dredging and disposal of spoils on the beach are to be described in the Wetlands Application. The return water from the spoils placement is to be described in the Waste Discharge application.

Both of these applications were used in the previous Saco River dredging and you can use your file copies as guide.

Receipt of the two permits will suffice for concurrance of compliance with Maine's approved Coastal Zone Plan.

Sincerely,

TECO BROWN, Director
Division of Licensing & Review
Bureau of Land Quality Control

TB/ltn

Encls.

REGIONAL OFFICES
• Portland • • Bangor • • Presque Isle •

CITY OF SACO

OFFICE OF THE CITY ADMINISTRATOR
Saco City Hall
300 Main Street, Saco, Maine 04072

Telephone: (207) 282-4191

November 16, 1981

Colonel C. E. Edgar III
Division Engineer
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Edgar:

We have reviewed a drafted detailed project report for improvements to Camp Ellis Harbor. We are in agreement of the findings of the document and we decided to have you proceed with construction of the improvements.

We are able at this time to sign the assurances required, as stipulated in the document.

Sincerely,

David B Wright

David B. Wright
City Administrator

DBW/jm

SECTION C

COORDINATION ACTIVITIES

The following list is a compilation of those agencies, interested groups, and the public who were consulted in the preparation of this report.

Federal Agencies

US Department of the Interior, Fish and Wildlife Service
US Department of the Army, Cold Regions Research and Engineering Laboratory

State Agencies

Department of Marine Resources
Department of Transportation
Maine Coastal Zone Management

Local Government Agencies

City of Saco, Maine

Elected Officials

David F. Emery, Representative in Congress
John McSweeney, State Representative, District of Old Orchard and Saco

Individuals

Donald R. Abbott, Saco, Maine
Christian M. Adam, Saco, Maine
Lionel Chevalier, Saco, Maine

CAMP ELLIS HARBOR
SACO RIVER
SACO, MAINE

DETAILED PROJECT REPORT

APPENDIX 4

ENGINEERING INVESTIGATION, DESIGN, AND COST ESTIMATES

Prepared by the
Department of the Army
Corps of Engineers
New England Division

APPENDIX 4

TABLE OF CONTENTS

LIST OF FIGURES

ENGINEERING INVESTIGATIONS, DESIGN AND COST ESTIMATES

Statement of the Problem

The principal winter navigation problem in the Saco River at Camp Ellis Harbor is the presence of ice floes that move through the existing anchorage areas and inflict damage upon commmercial fishing vessels attempting to operate during the winter.

ICE FLOE

Ice Floe Data Collection

In considering the design of an ice breaker system, the following types of data were required:

1. Ice floe patterns
2. Ice floe velocity
3. Ice floe size

In order to determine ice floe patterns, several local fishermen were questioned regarding their observations. It became apparent that the path of the ice floe varies considerably due to the wide range of answers obtained. The only conclusive information obtained was that the ice sheets form on cold nights (less than 15^{o}), during an incoming tide with minimum wind conditions.

A system for monitoring the ice floe patterns using triangulation control was set up to observe and measure the ice floe movement. Two of the control points were previously used by the Corps of Engineers, "Triangle Wall," and "Moore." The third point was established at Jordan Point, Saint Francis College, by triangulation with the other two points. By positioning transits at Jordan Point and Triangle Wall, the ice floes were monitored as they broke off the ice sheet near Windmill Point and floated downstream beyond the anchorage.

Exact points on ice floes were marked by placing color coded buoys on the ice before it broke off and started moving downstream. The work was coordinated via radio communication so that location "sightings" on the color coded buoys could be done simultaneously.

The average velocity of the individual ice floe movements was calculated by dividing the distance traveled in feet by the travel time in minutes between sightings.

The size of each ice floe could only be estimated since the exact edge of an ice floe was difficult to locate and because of the many irregular shapes that were formed. Judgement was used to estimate the size and thickness of the ice floes. From there it was relatively easy to compute an estimated weight per floe.

Using these techniques, there was considerable delay, in the data collection phase, because it was necessary to wait for the proper conditions i.e., incoming tide, minimum wind conditions and ambient temperatures less than 15°F. These conditions occurred and data was collected on February 1, 2, 3, and 18, 1977.

Data Analysis and Discussion - Ice Floe

The data collected on each of the 4 days was plotted on Figures 4-1 through 4-4 and tabulated in Tables 4-1 and 4-4 respectively.

An analysis of the plotted data and field observations indicate that the ice floe movement patterns are related, primarily, to channel currents. Due to the complexity of the currents, however, a variety of patterns of movement were obvious.

However, it was apparent that as the ice broke free it was carried downstream by the currents. The river currents varied depending on the width and depth of the river, position of the floe in the river, such as the main channel and/or side waters, and tides. It is realized that many other variables affect the currents, but they were not considered significant or measurable in plotting ice floe movement.

TABLE 4-1
ICE FORMATION AND MOVEMENT - DATA SUMMARY
(FOR FEB. 1, 1977 - SEE FIGURE 4-1)

Marker Sighting	Time (A.M.)	Distance (Feet)	Velocity (fpm)
K1	11:41		
K2	11:43	475	238
K3	11:46	500	167
K4	11:48	340	170
L1	11:40		
L2	11:44	520	130
L3	11:46	450	225
L4	11:48	350	175
M1	11:39		
M2	11:47	530	177
N1	9:30		
N2	9:39	300	33
N3	9:40	270	270
N4	9:42	210	105
N5	9:51	435	48
N6	9:54	120	40
N7	12:11 P.M.	50	<1
R1	9:27		
R2	9:59	1550	48
R3	10:00	180	90
R4	10:01	90	90
S1	9:27		
S2	10:06	1005	26
S3	10:09	465	155
S4	10:12	460	153
S5	10:13	310	310
S6	10:18	450	90
S7	10:20	290	145
DF1	12:15 P.M.	195	65
DF2	12:18	150	150
DF3	12:19	170	170
DF4	12:20	170	85
DF5	12:22	130	130
DF6	12:23	140	70
DF7	12:25		

TABLE 4-2
ICE FORMATION AND MOVEMENT - DATA SUMMARY
(FOR FEB. 2, 1977 - SEE FIGURE 4-2)

Marker Setting	Time (A.M.)	Distance (Feet)	Velocity (fpm)
OW1	12:20 P.M.		
OW2	12:27	80	11
OW3	12:29	50	75
OW4	12:30	140	140
OW5	12:31	180	180
OW6	12:32	240	240
OW7	12:35	480	160
YW1	10:40 A.M.		
YW2	10:51	735	67
YW3	10:59	270	34
YW4	11:06	640	91
BW1	10:45		
BW2	10:51	650	108
BW3	11:05	1800	129
BY1	10:35		
BY2	10:57	1150	52
BY3	10:58	110	110
YB1	10:45		
YB2	10:51	515	86
YB3	10:59	700	88
YB4	11:07	320	40
RB1	10:51		
RB2	11:06	850	57
RW1	10:34		
RW2	10:45	120	11
RW3	12:02 P.M.	860	11
RW4	12:04	130	65
RW5	12:05	110	110
RW6	12:06	90	90
RW7	12:10	325	81
RW8	12:13	270	90
YO1	10:35		
YO2	10:41	350	58
YO3	10:48	560	80
YO4	12:11	960	42
YO5	12:12	320	320

TABLE 4-3
ICE FORMATION AND MOVEMENT - DATA SUMMARY
(FOR FEB. 3, 1977 - SEE FIGURE 4-3)

Marker Sighting	Time (A.M.)	Distance (Feet)	Velocity (fpm)
BW1	9:54		
BW2	10:26	2400	75
YO1	9:55		
YO2	10:58	960	15
YO3	11:02	270	68
YO4	11:22	1490	75
OY1	10:46		
OY2	10:58	485	40
OY3	11:18	1400	70

TABLE 4-4
ICE FORMATION AND MOVEMENT - DATA SUMMARY
(FOR FEB. 18, 1977 - SEE FIGURE 4-4)

Marker Sighting	Time (A.M.)	Distance (Feet)	Velocity (fpm)
1-1	9:35		
		220	7
1-2	10:08	175	9
1-3	10:28	345	16
1-4	10:49	155	11
1-5	11:03	315	12
1-6	11:30	330	22
1-7	11:45		
2-1	9:35		
		260	7
2-2	10:15	125	10
2-3	10:28	485	14
2-4	11:03	310	12
2-5	11:29	560	24
2-6	11:52	240	40
2-7	11:58	335	67
2-8	12:02 P.M.		
3-1	9:35		
		195	6
3-2	10:07	665	13
3-3	11:00	250	9
3-4	11:27		
6-1	9:37		
		280	10
6-2	10:06	150	8
6-3	10:26	480	12
6-4	11:05	230	10
6-5	11:27		
8-1	9:37		
		150	4
8-2	10:12	630	13
8-3	11:01	470	6
8-4	12:24 P.M.	320	107
8-5	12:27	630	126
8-6	12:32	360	120
8-7	12:35		
12-1	9:42		
		200	7
12-2	10:11	160	9
12-3	10:29	280	18
12-4	10:45		

TABLE 4-4 (Cont'd)

Marker Sighting	Time (A.M.)	Distance (Feet)	Velocity (fpm)
16-1	9:41		
16-2	10:10	265	9
16-3	12:30 P.M.	1140	8
16-4	12:33	310	103
16-5	12:37	280	70
16-6	12:43	585	98
17-1	9:41		
17-2	10:05	470	20
17-3	10:33	210	8
17-4	10:48	230	15
17-5	11:50	710	355
17-6	12:01 P.M.	400	36
17-7	12:06	470	94
18-1	9:40		
18-2	10:06	265	10
18-3	10:32	190	7
19-1	11:08		
19-2	11:28	165	8
19-3	11:48	430	22
19-4	11:59	430	39
19-5	12:05 P.M.	490	82
20-1	9:39		
20-2	10:06	270	10
20-3	10:14	70	9
20-4	10:31	110	6
20-5	11:08	370	10
20-6	11:29	150	7
21-1	12:07 P.M.		
21-2	12:11	140	35
21-3	12:18	170	24
21-4	12:23	160	32
21-5	12:26	170	57
21-6	12:31	350	70

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SACO RIVER-CAMP ELLIS HARBOR, SACO, MAINE. SMALL NAVIGATION PRO--ETC(U)
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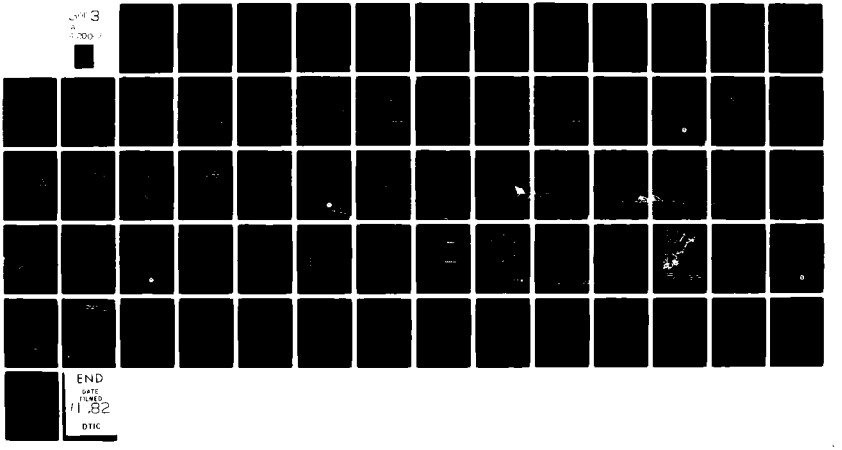

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Upstream of Jordan Point, where the main channel of the river is fairly deep, there is a point of curvature. At this point the current appears to rebound off Jordan Point and the stone jetties toward the anchorage. It is well known that a swift current tends to follow the outer edge of a curve and, as a river ages, "S" type channel curves are formed. This would indicate that the swiftest water in the channel passes through the anchorage. An examination of the data supports this hypothesis. Ice floe sheets that break off upstream of Jordan Point follow the current and also pass through the anchorage, while those that are not in the main channel drift in a more random pattern. This may be explained by assuming that sidewater currents are slower and form small eddies that do not have a predictable effect on ice movement.

A second important factor in predicting the various river currents, and consequently ice floe patterns, is the tide. It is already known that as tidal water flows into a fresh water river the fresh water will rise and "float" over the salt water. This is why the ice sheets form such strong hard ice. This condition, however, changes the flow patterns in the river. It was observed that ice floe sheets would break off and start to float downstream while the lower tidal current was still flowing upstream. When the tide reached its peak the entire river would then begin the flow downstream. An examination of the plotted data indicates that ice move- movement prior to high tide is slower. The direction, however, was generally downstream, but there was more lateral movement than after high tide.

The stage of the tide which affected the river currents was a primary influence on the velocity of the ice floe. Prior to high tide the velocity of the ice floes was in the 0-15 feet per minute range. After high tide, the velocity of the ice sheets increased and in some cases traveled over 300 feet per minute. The varying ice floe velocities indicate that the river currents must also vary. The ice sheets, in many cases, were traveling at over 100 feet per minute through the anchorage.

The wind was also thought to be a factor in determining the ice floe movement patterns. After examining the plotted data, it was concluded that the wind did not affect the movement patterns. Of particular interest are Figures 4-2 and 4-4. In each case the actual ice floes moved into the wind. In neither case did it appear that the ice sheets were influenced by the wind. It was concluded that ice floe movement was governed solely by the river currents. However, the wind did appear to have an affect on the ice sheets in that rough choppy water surfaces tended to break the ice floes into smaller sheets.

The size of the individual ice sheets varied considerably. It was estimated that the sheet ice varied between 3 and 200 tons, with the average floe being in the 5-15 ton range. The thickness varied from 1/4" to 1/2" and the diameter from 100 to 200 feet.

In summary, the ice floe movement patterns are primarily affected by the river currents; the river currents appeared to change with changes in the channel width and depth, position of the ice floe sheet in the river, and the tide. The freezing factors directly affected the velocity and direction of the ice floe movement.

Based upon the data and field observations, it was concluded:

1. Although the ice floe movement pattern appeared to be random it was governed by the river currents.

2. River currents were variable, depending on the width and depth of the river, the velocity profile of the river and the tide.

3. The wind had a negligible effect on ice floe movement.

4. The wind did affect the size of the ice floes in that strong winds tended to break up the ice sheets.

5. A substantial portion of the river flow appeared to pass directly through the existing anchorage. Therefore during typical winter conditions a certain amount of ice floes will pass through the anchorage.

6. The size of ice floe sheets varied from small harmless sheets to sheets large enough to crush and sink fishing boats.

7. The main channel flow appears to rebound off from Jordans Point and the stone jetties toward the anchorage.

HYDROGRAPHIC SURVEYS

A hydrographic condition survey of the project area was performed in the winter of 1980 (Figure 4-10). This survey did not include the upstream areas as information on the existing anchorages is readily available.

SUBSURFACE INVESTIGATIONS

Test Borings

Test borings were taken at the locations shown in Figure 4-5 to obtain an indication of subsurface conditions in the project area. These borings indicate that the river bottom is composed of SP-SM material. This information is summarized in Figures 4-6 through 4-9.

Seismic Survey

A seismic survey was conducted on 18 July 1979. The specific objective of this survey was to measure the sediment thicknesses at the two sites in order to determine if there is at least 35 feet of unconsolidated material

through which to drive pilings for construction of ice breaker structures. This survey was also used to determine subsurface bedrock conditions to develop quantity estimates for the breakwater alternative proposed in Plan B. Bedrock contours developed from the seismic survey are shown in Figure 4-11.

CONCLUSIONS

The results of the test borings and seismic survey revealed that the depth of the bedrock surface immediately above the city pier was approximately 100 to 120 feet below mlw. It is therefore inferred that similar depths to bedrock will be encountered in the area immediately below the pier which is the area of recommended improvement.

ANCHORAGE CROSS SECTIONS

In order to determine the quantities of material to be dredged, data derived from the hydrographic survey and subsurface investigations were used to develop cross sections of the area to be dredged under Plans C and D. Three typcial cross sections are shown in Figures 4-12, 4-13, and 4-14. The location of these cross sections and their relation to the two alternative anchorage alignments is shown in Figure 4-15.

NATURE OF MATERIAL TO BE REMOVED

In order to determine the exact physical nature of the material to be removed and its suitability as beach nourishment material, mechanical analyses were analyzed from two samples taken from the estuary study area above the city pier. The results of several past samples from the existing 8 foot channel, taken in conjunction with previous maintenance dredging projects, were also reviewed. The locations of these samples are shown in Figure 4-16. Physical test results for samples taken in conjunction with maintenance dredging in 1972 and 1976 are shown in Table 4-5. Grain size curves developed for the two samples taken in 1979 from the anchorage above the pier are shown as Figures 4-17 and 4-18. This data leads us to expect that the material to be removed from below the city pier will have a mean grain size diameter of at least 0.8 mm and is therefore suitable for use as beach nourishment sand.

QUANTITY AND COST ESTIMATES

Quantities of Material To Be Removed

Estimates of material to be removed are based on hydrographic surveys of the existing bottom of the anchorage (Figure 4-10) and test borings (Figures 4-6 through 4-9).

TABLE 4-5

PHYSICAL TEST RESULTS - SEDIMENT SAMPLES
CAMP ELLIS HARBOR, SACO RIVER, SACO, MAINE

PARAMETER	1972 SAMPLES			1976 SAMPLES	
	GE-1 Below Pier	GE-2 Opposite Pier	GE-3 Above Pier	GE-1 Above Pier	GE-6 Below Pier
Visual Classification	Brown coarse to medium SAND with shell and wood fragments	Black course to fine SAND w/shell and organic material	Black uniform Medium to Fine SAND w/shell fragments and organics	Tan medium to fine SAND with pieces of wood	Tan medium to fine SAND w/shell fragments
Grain Size-Median (mm)	0.9	0.6	0.41	0.68	0.80
" D75	1.4	1.3	0.68	0.81	1.20
" D25	0.67	0.3	0.30	0.50	0.60
Sorting Coef	1.446	2.082	1.506	1.273	1.414
Normal (N) or Bimodal (B) curve	N	N	N	B	B
Specific Gravity	2.647	2.619	2.662	2.620	2.650
% Fines	0.1	1.9	0.9	0.0	0.4
Percent Solids	81.62	76.71	78.99	81.12	93.95
% Volatile Solids - EPA	0.43	1.48	0.95	0.87	0.49
% Volatile Solids - NED	0.35	1.01	0.76	0.67	0.35

NOTE: All samples were surface grabs.

The dredged quantities were determined by using the above mentioned investigations to develop cross-sections of the anchorage. The average cross-sectional area and width were multiplied to determine the volume of each section. In these computations a 1-foot overdredge was assumed in areas where a sandy bottom exists. No evidence of rock was found in the project area.

Downstream Anchorage Dredging

The proposed 3 acre downstream anchorage area is located immediately below the city pier and adjacent to the southern end of Camp Ellis Beach and the north breakwater. The area would be dredged to a depth of 6 feet at mean low water. The side slopes of the anchorage would have to be 1:3 in the sandy bottom to provide reasonable stability. The total quantity of material to be removed by dredging the recommended plan, then, was calculated to be 9,400 yards of sand.

DREDGING AND DREDGING COST ESTIMATES

The values presented are based on the use of a 12-inch hydraulic dredge, a derrick barge, a pipe barge, one 400 horsepower tug and a 165 HP launch. Labor costs were based on three eight hour shifts per day, seven days per week. Values also include mobilization and demobilization costs and a contractor profit of 10 percent. Table 4-6 shows a first cost breakdown of dredging and disposal costs assuming the disposal site is Camp Ellis Beach. All costs are based on March 1981 price levels.

TABLE 4-6

PLAN C

Dredging 9,400 yd^3 of ordinary material @ 9.25/yd^3	$86,900
Contingencies (20%)	17,400
Engineering and Design	8,300
Supervision and Administration	8,300
Aids to Navigation	4,000
TOTAL	$124,900

PLAN D

Dredging 12,400 yd^3 of ordinary material @ 9.25/yd^3	$115,600
Contingencies (20%)	23,100
Engineering and Design	11,100
Supervision and Administration	11,100
Aids to Navigation	4,000
	$164,900

ICEBREAKER DESIGN

General Information

Icebreaker structures were designed to break and/or deflect ice floes moving down the Saco River and into Camp Ellis Harbor. Consultation was initiated with the Cold Regions Research and Engineering Laboratory in order to assure that the structures were properly spaced and design loads were adequate for the anticipated ice loadings. Based on this consultation a spacing of 50 feet between structures was assumed to be the maximum distance that would sufficiently break/deflect ice floes and allow vessels that normally use Camp Ellis Harbor to navigate between the structures. CRREL recommended designing the icebreakers for that loading where the ice would crush itself against the pile structure. The ice that forms upstream in the river and ultimately flows through the harbor area is predominantly composed of brackish ice as the tidal influence extends approximately 6 miles upstream. To crush this type of ice a design load of 200 psi (specified in CRREL recommendation) was used in the design of the pile icebreaker structures. Two alternate pile structures designs, one of wood, the other of steel, were evaluated. Structures were designed in accordance with the procedures set forth in the Naval Facilities Design Manual 7.

Wooden Pile Icebreaker

The wooden pile cluster icebreaker design consists of a series of six wooden piles surrounding a central wooden pile. Each pile contained in the icebreaker would be 12 inches in diameter and 45 feet long. The cluster would be bound together in two locations by 7 turns of 1 inch diameter galvanized wire rope with each turn stapled to each pile (requiring approximately 140 linear feet of galvanized rope per 1 icebreaker). One wrapping would be at the low water level and the other at the high water mark. The central pile would be driven perpendicular to the water surface and the other 6 piles would be driven at 1 on 10 slope and embedded approximately 20 feet in the riverbed. This is illustrated in Figure 4-19. The wooden piles would be pressure treated and have an estimated life of 25 years, as damaging wood borers have not been observed in the Saco River and the major influence on pile life is assumed to be the abrasion caused by the impact of ice floes against the icebreaker structures.

Steel Pile Icebreaker Structure

The steel pile icebreaker design consists of a single 24 inch diameter steel pipe pile with 1/2" wall thickness, 45 feet long meeting ASTM specification A252. Each pile would be coated with C200 coal tar epoxy. Piles will be placed by hammering or hydraulic jetting and then filled with sand. The piles will be jetted approximately 20 feet into the river bottom, which is composed of SP-SM material. This design is shown on Figure 4-20. The design life of this structure is estimated to be 25 years.

Osprey Nest Design

Plans involving pile installation include the provision of constructing an osprey nesting platform. The nest was included at the suggestion of the U.S. Fish and Wildlife Service in a letter dated 16 January 1979. The design is based on a sketch also supplied by the U.S. Fish and Wildlife Service and is shown on Figure 4-20. The platform will be constructed of pressure treated wood and mounted on a 12 inch diameter timber pile extending 25 feet above mean high water (20 feet above the top of the pile structure).

The method of attaching the platform pole to the icebreaker structure varies depending on whether or not the pile design is of steel or wood. The installation of the platform on a steel pile would involve inserting the platform support pole into the 24 inch diameter pile and standing it on the channel bottom, filling the remaining void with sand; and driving and bolting wedges between the pole and pile at elevation +15 (See Figure 4-20). Installing the platform on a wooden pile structure would involve either lashing the pole supporting the platform to the center pile or attaching it to the center pile with a steel collar structure.

ICEBREAKER COST ESTIMATES

Placement of icebreaker structures would be accomplished by the same contractor dredging the anchorage and using most of the same equipment involved in the dredging operation. Wooden pile structures could be placed at the rate of approximately 400 linear feet per day. Steel piles could be placed at the rate of approximately 250 linear feet per day. Depending on the selected plan and material, the icebreaker installation could be completed in 3 to 10 days under favorable weather conditions.

FIRST COSTS

The cost of a wooden pile icebreaker structure with a 25 year life is $9,300. The cost of a steel icebreaker structure with a 25 year life is $6,000. Therefore, steel pile structures were selected for use as they provide the lowest cost structure capable of providing the desired level of protection over the life of the project. Table 4-7 shows a breakdown of initial costs of icebreaker construction and emplacement including the osprey nest costs for the three plans involving icebreakers.

TABLE 4-7

PLAN A

15 Icebreakers @ $6,000/ea.	$ 90,000
1 Osprey Nest	3,000
SUBTOTAL	$ 93,000
Contingencies (20%)	18,600
Engineering and Design	8,900
Supervision and Administration	8,900
TOTAL	$129,400

PLAN C

13 Icebreakers @ $6,000/ea.	$78,000
Osprey Nest	3,000
SUBTOTAL	$81,000
Contingencies (20%)	16,200
Engineering and Design	7,800
Supervision and Administration	7,800
TOTAL	$112,800

PLAN D

11 Icebreakers @ $6,000/ea.	$66,000
Osprey Nest	3,000
SUBTOTAL	$69,000
Contingencies (20%)	13,800
Engineering and Design	6,600
Supervision and Administration	6,600
TOTAL	$96,000

SUMMARY OF ICEBREAKER COSTS

PLAN A	$129,400
PLAN C	$112,800
PLAN D	$ 96,000

REPLACEMENT COSTS

Replacement of icebreakers constructed of wood or steel are anticipated every 25 years or at project year 25. These replacement costs are included in the annual maintenance figures.

TABLE 4-8

SUMMARY OF FIRST COSTS

	DREDGING	ICEBREAKERS	TOTAL FIRST COST
A	—	129,400	$131,400
C	124,900	112,800	$237,700
D	164,900	96,000	$260,900

MAINTENANCE DREDGING

The recommended plan entails anchorage dredging and would require periodic maintenance dredging.

Following initial dredging the anchorage area will tend to shoal or fill in because of settlement of side slopes, deposition of material derived from upland erosion, and the actions at currents.

Although anchorage side slopes will be designed in such a way to enhance long term stability, changes in the bottom contours will occur over time resulting in gradual flattening of the slopes. Strong wave or current action occurring during storms may result in the movement of bottom sediments. The propeller wash and wakes produced by passing vessels will also tend to disturb the river bottom, resulting in redistribution of bottom materials.

The rate of shoaling in the proposed anchorage has been estimated from condition surveys to be 2 inches per year. For the purposes of the cost estimates, an annual shoal rate equal to 8.5 percent of the initial dredged volume has been used. Table 4-9 gives a summary of maintenance costs associated with maintenance dredging.

Based on a 6 foot anchorage depth, the one foot overdredge would be eliminated in about 6 years. Therefore, maintenance dredging would be required at 6 year intervals to maintain the desired anchorage depth.

TABLE 4-9
MAINTENANCE DREDGING COSTS

PLAN C
Annual Amount = 800 c.y.
Amount in 6 years = 4,800 c.y.
Annual Maintenance Cost = 800 cy @ $10.75 c.y. = $8,600

PLAN D
Annual Amount = 1,050 c.y.
Amount in 6 years = 6,300 c.y.
Annual Maintenance Cost 1,050 cy @ $10.75 c.y. = $11,300

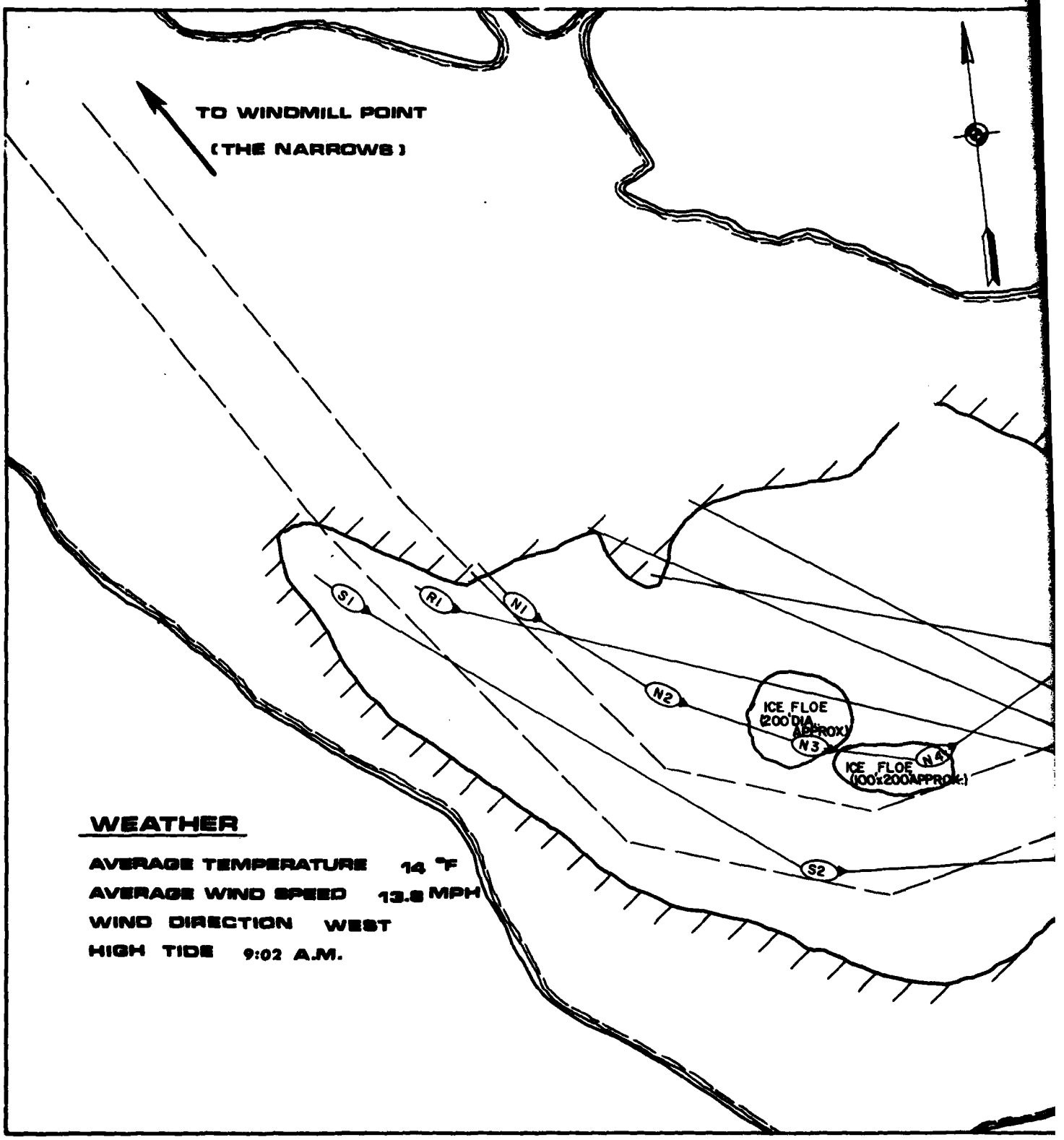
DISPOSAL OF DREDGED MATERIAL

Two sites were investigated as possible locations for disposal of dredged material. One, an ocean dumpsite, is located approximately 3 miles south of Cape Arundel or 15 nautical miles by sea from Camp Ellis Harbor (see Figure 4-21). The second site, which is the recommended disposal site, is Camp Ellis Beach located directly across the north breakwater from the dredge site, a distance of about 500 feet.

The cost of transporting the dredged material to Cape Arundel for ocean disposal was shown to be significantly greater than the cost of using a hydraulic dredge pump to deposit the material on the beach side of the breakwater. The material was shown to be clean medium grained sand and was determined to be ecologically acceptable for beach nourishment purposes. The choice of the beach nourishment site also avoids the possibility of adverse environmental impacts associated with ocean disposal at the Cape Arundel site which was last used for material dredged from the Kennebunk River during maintenance operations in 1975.

The sand to be dredged from the proposed anchorage area would be deposited along the southernmost 500 feet of beach at Camp Ellis (see Figure 4-22). Camp Ellis Beach has been subjected to continued erosion problems endangering shorefront properties and detracting from the areas recreational resources. Continued erosion of the beach could also lead to an outflanking of the breakwater and spur jetty, which would endanger the harbor and existing 8-foot channel.

For a more detailed analysis of the impacts of dredging and disposal of dredged material please see the environmental assessment contained in the Main Report.



WEATHER

AVERAGE TEMPERATURE 14 °F

AVERAGE WIND SPEED 13.8 MPH

WIND DIRECTION WEST

HIGH TIDE 9:02 A.M.

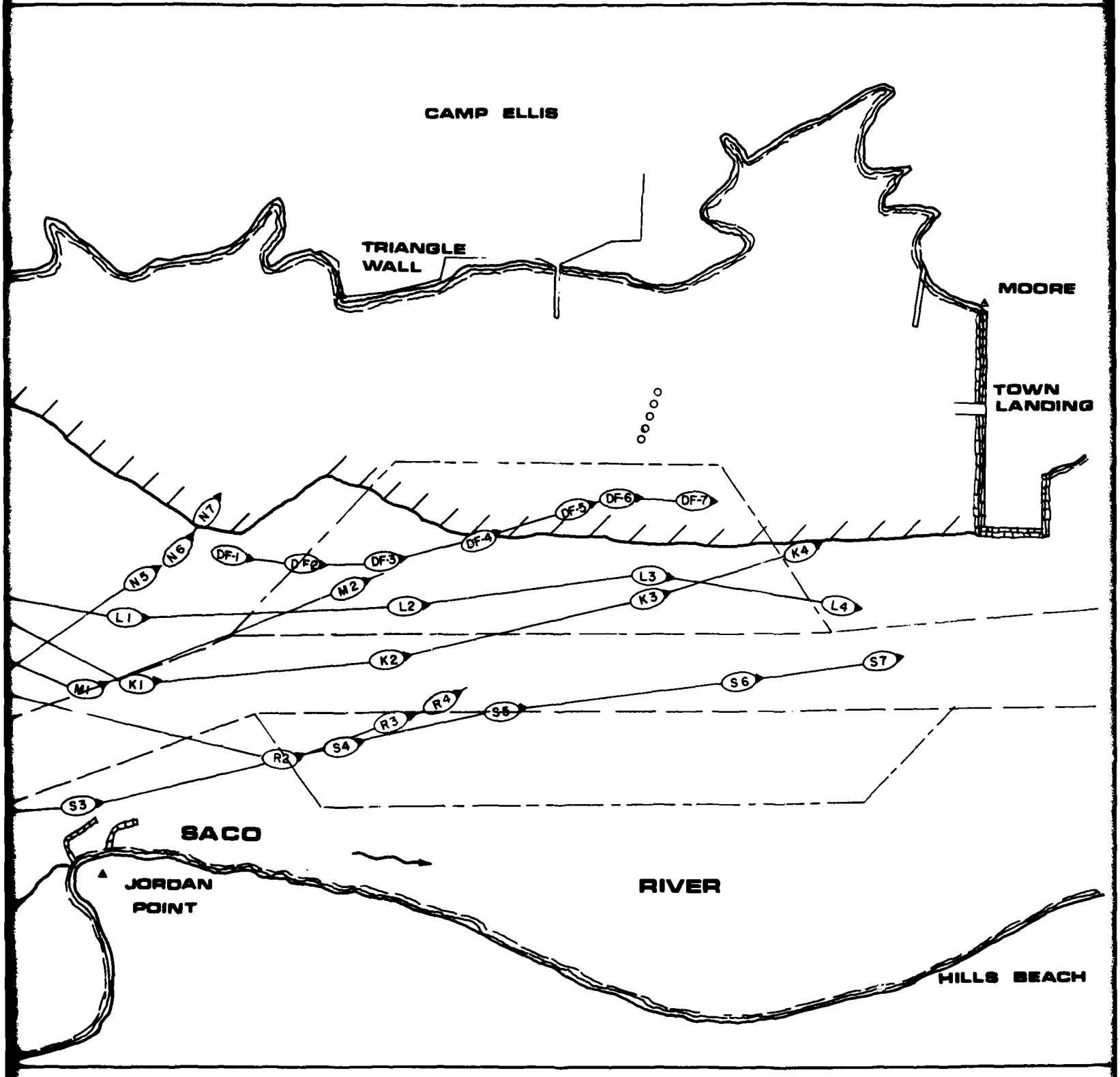

CAMP ELLIS
TRIANGLE WALL
MOORE
TOWN LANDING
N7
N6
N5
L1
M1
K1
DF-1
DF-2
DF-3
DF-4
DF-5
DF-6
DF-7
M2
L2
K2
K3
K4
L3
L4
S7
S6
S5
R4
R3
S4
R2
S3
SACO
JORDAN POINT
RIVER
HILLS BEACH

FIGURE 4-1

2

1

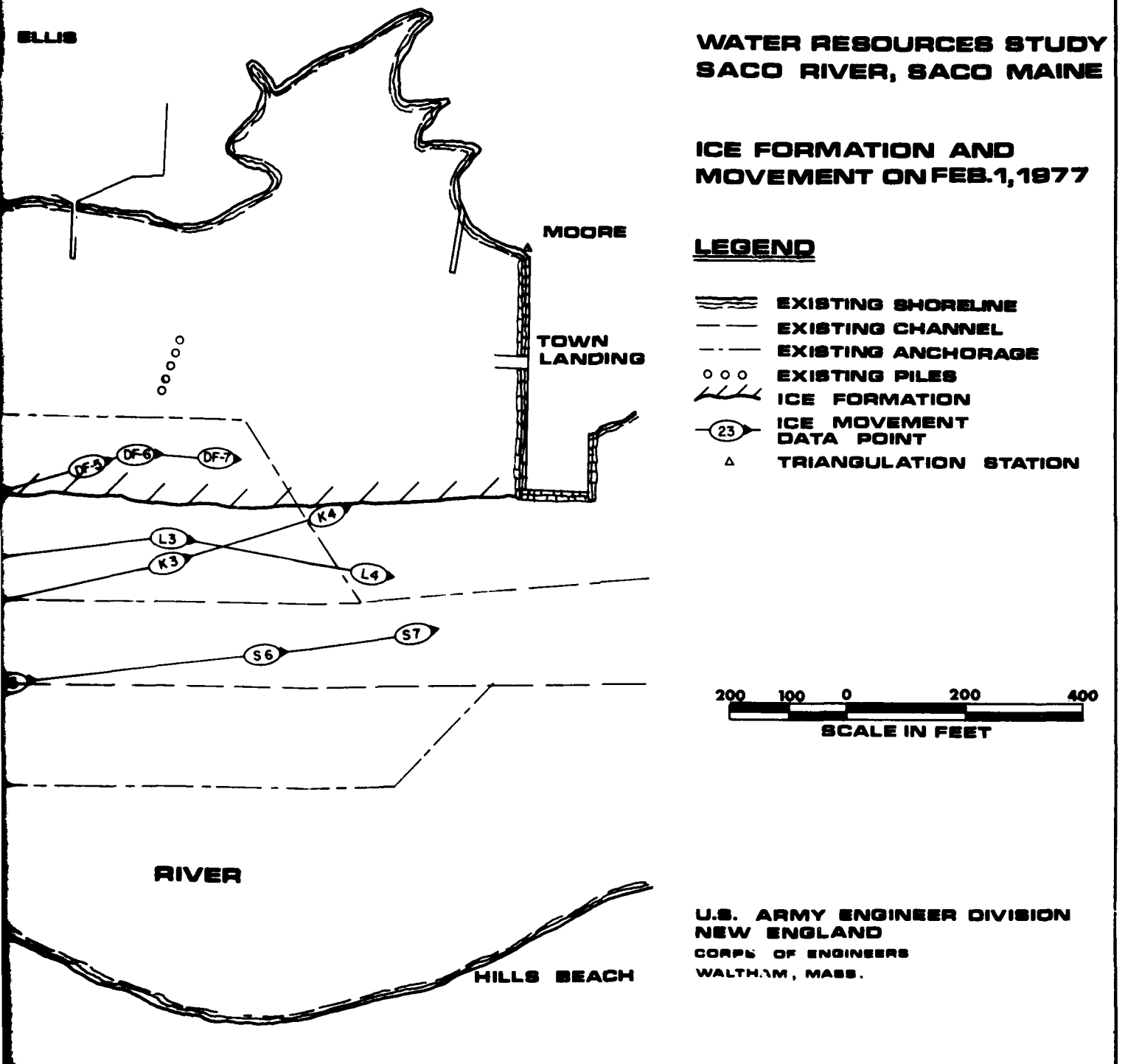
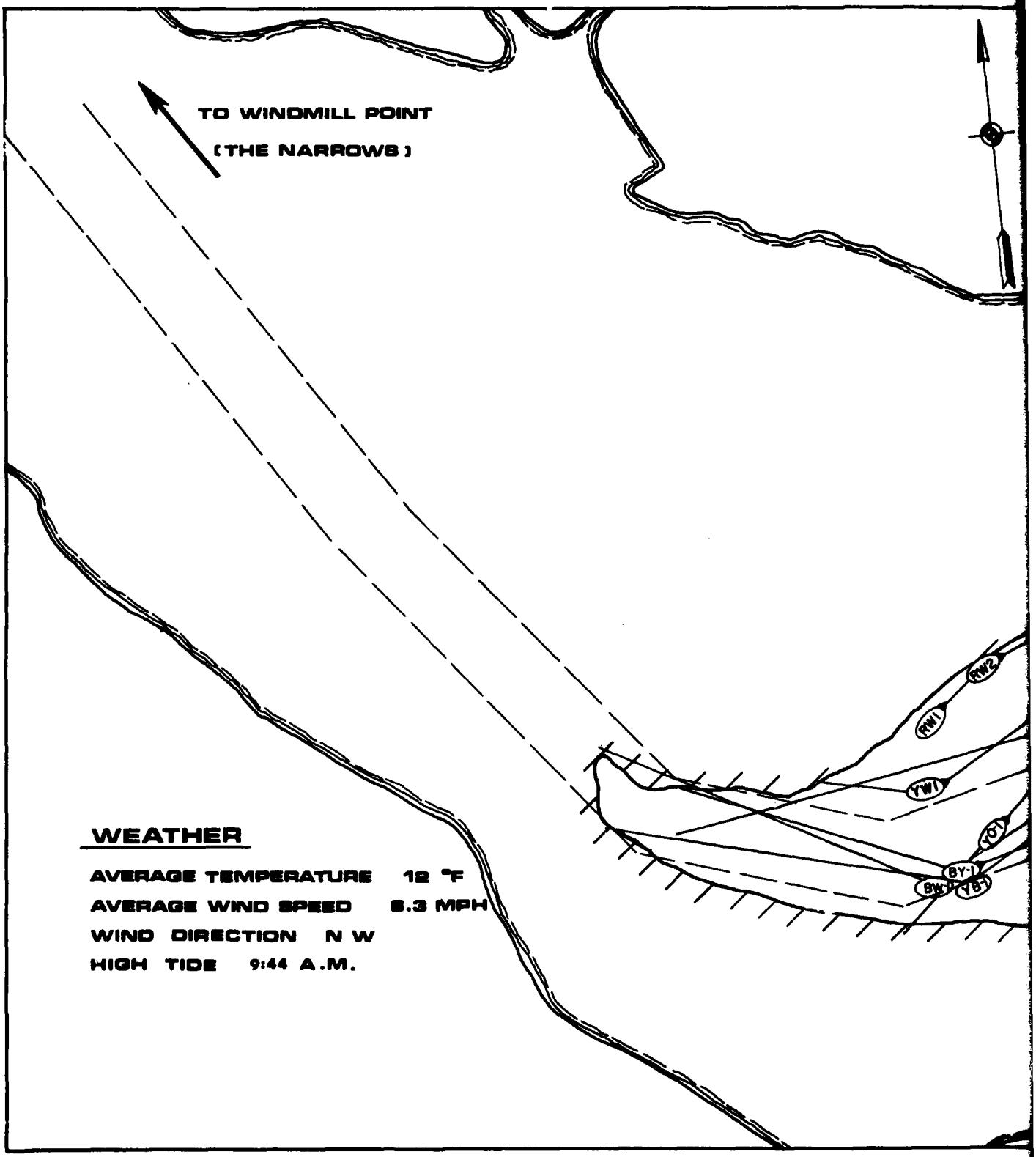
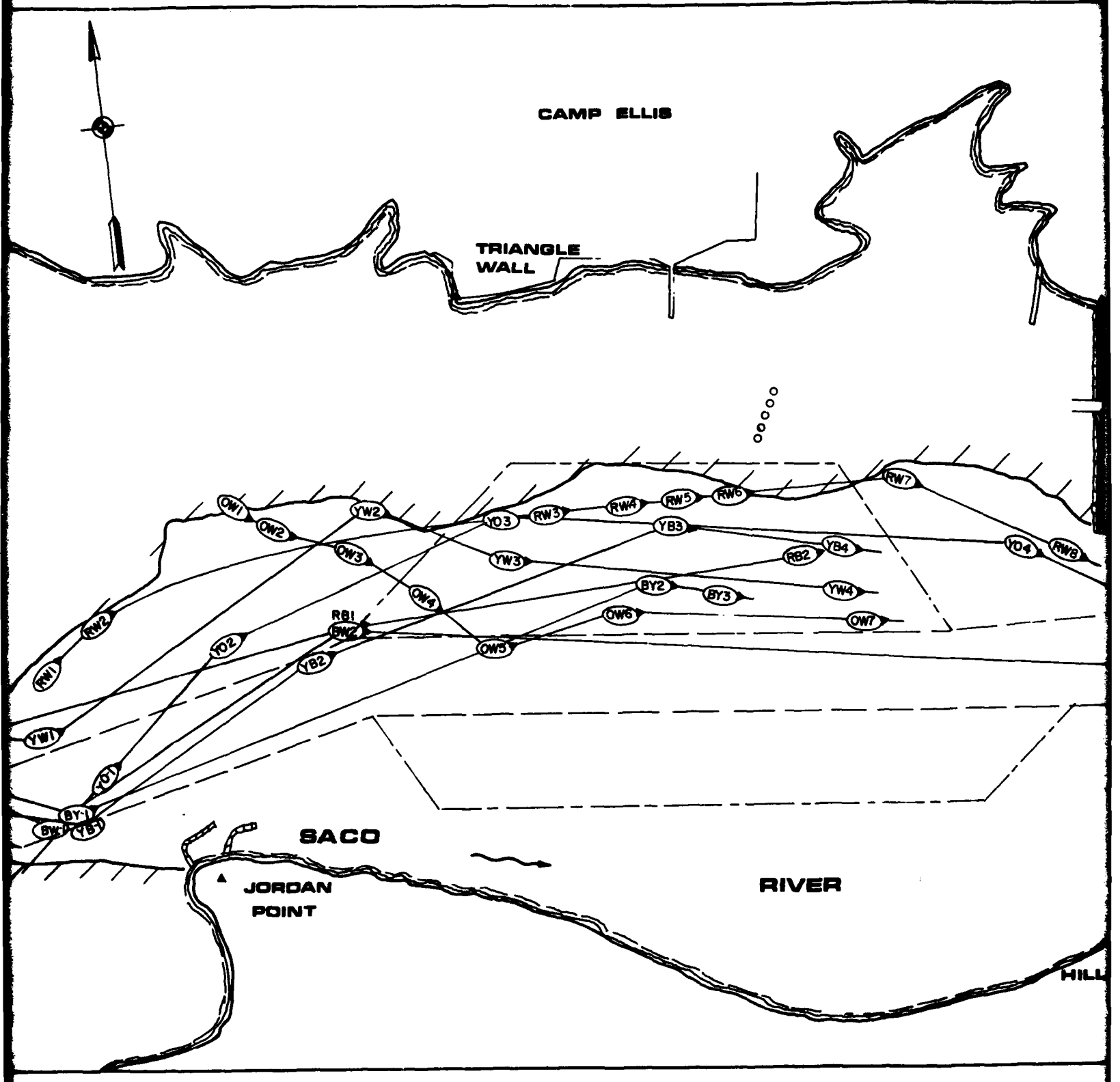
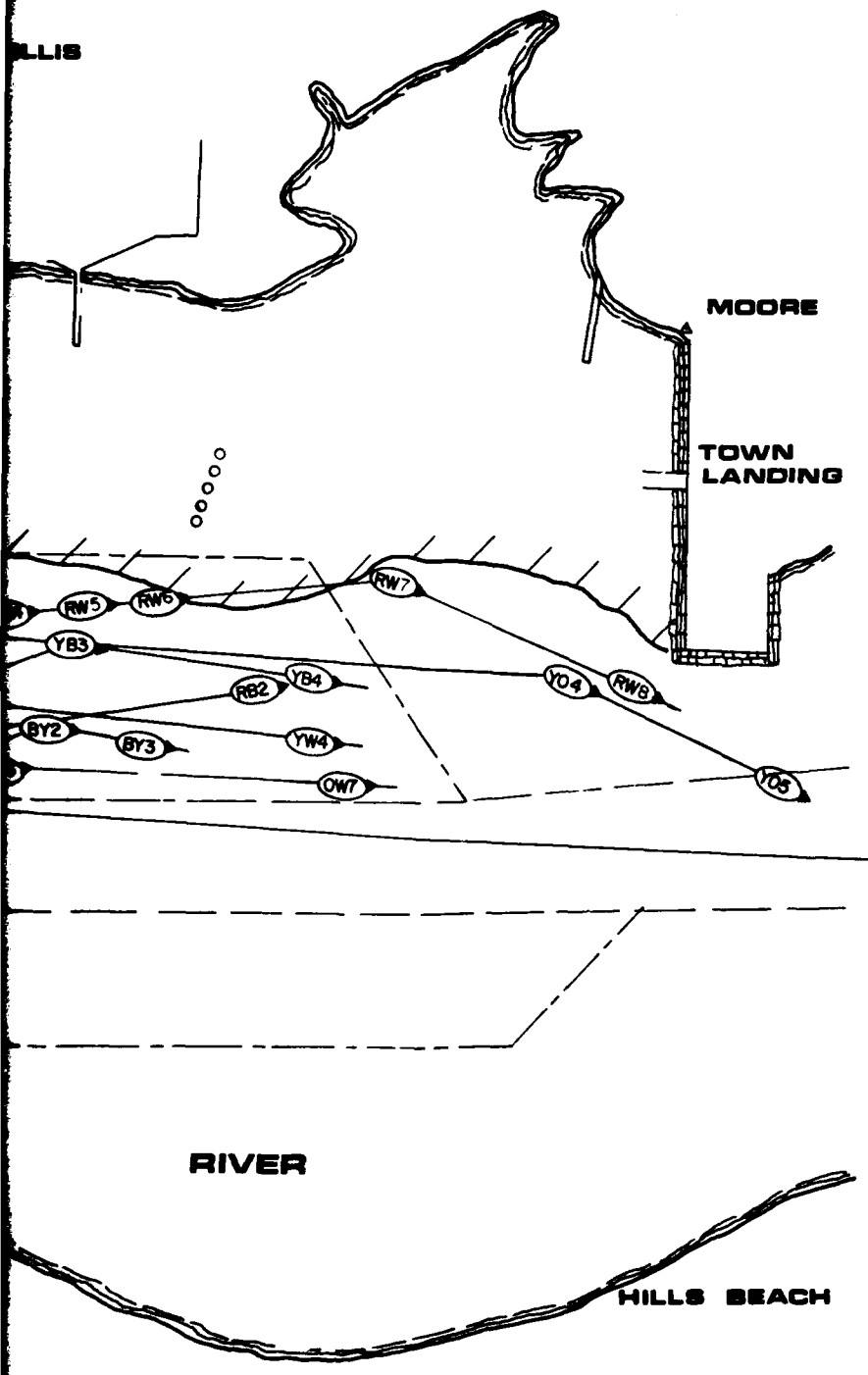


FIGURE 4-1

2 1 3


TO WINDMILL POINT
(THE NARROWS)
RW2
RW1
YW1
YO1
BY1
BW1
YB1
WEATHER
AVERAGE TEMPERATURE 12 °F
AVERAGE WIND SPEED 6.3 MPH
WIND DIRECTION N W
HIGH TIDE 9:44 A.M.


CAMP ELLIS
TRIANGLE WALL
OW1
OW2
OW3
OW4
OW5
OW6
OW7
YW1
YW2
YW3
YW4
YO1
YO2
YO3
YO4
YB1
YB2
YB3
YB4
RW1
RW2
RW3
RW4
RW5
RW6
RW7
RW8
RB1
RB2
BW1
BW2
BY1
BY2
BY3
SACO
JORDAN POINT
RIVER



WATER RESOURCES STUDY
SACO RIVER, SACO MAINE

ICE FORMATION AND MOVEMENT ON FEB.2,1977

LEGEND

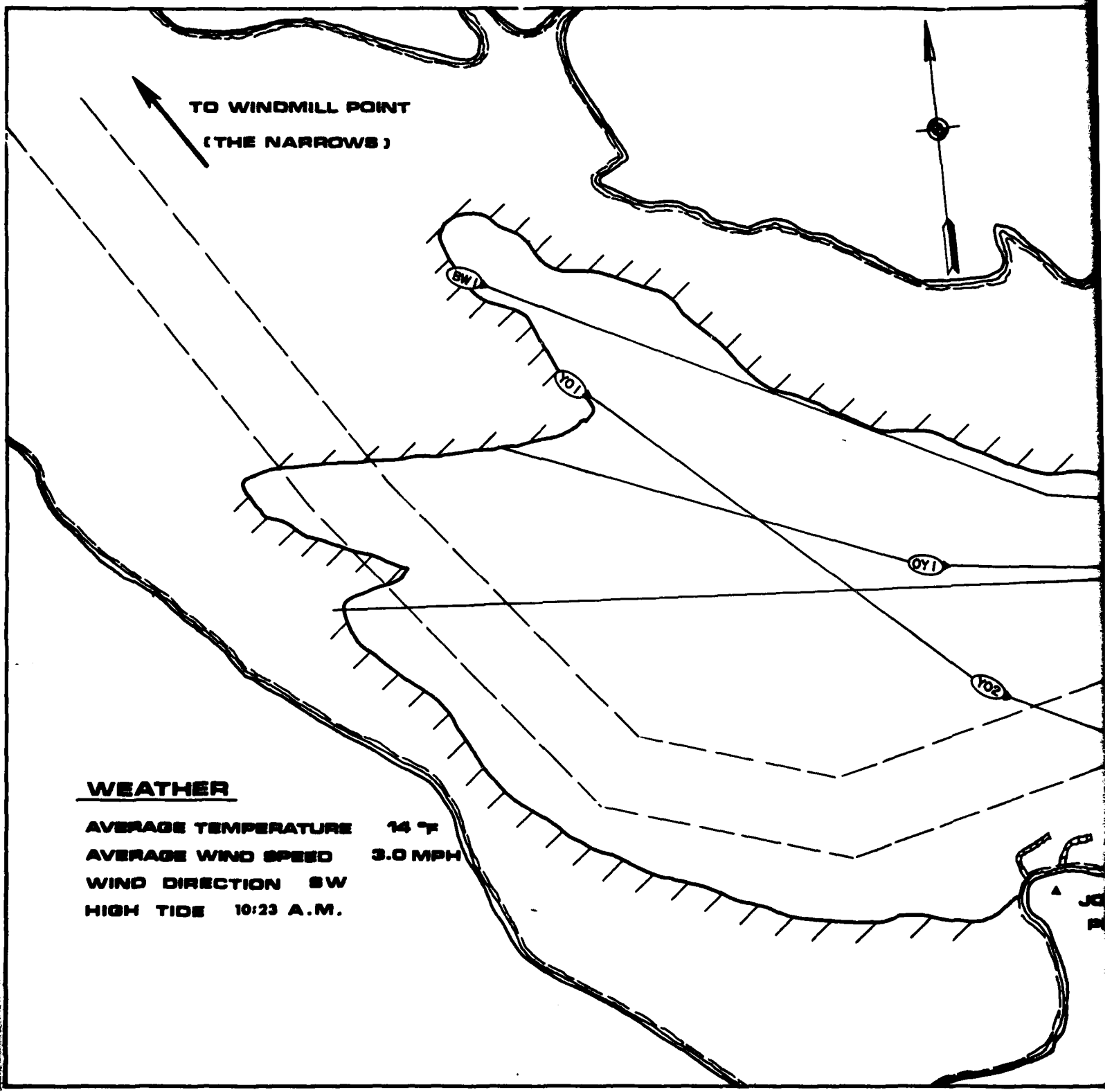
- EXISTING SHORELINE
- EXISTING CHANNEL
- EXISTING ANCHORAGE
- EXISTING PILES
- ICE FORMATION
- (23) ICE MOVEMENT DATA POINT
- △ TRIANGULATION STATION

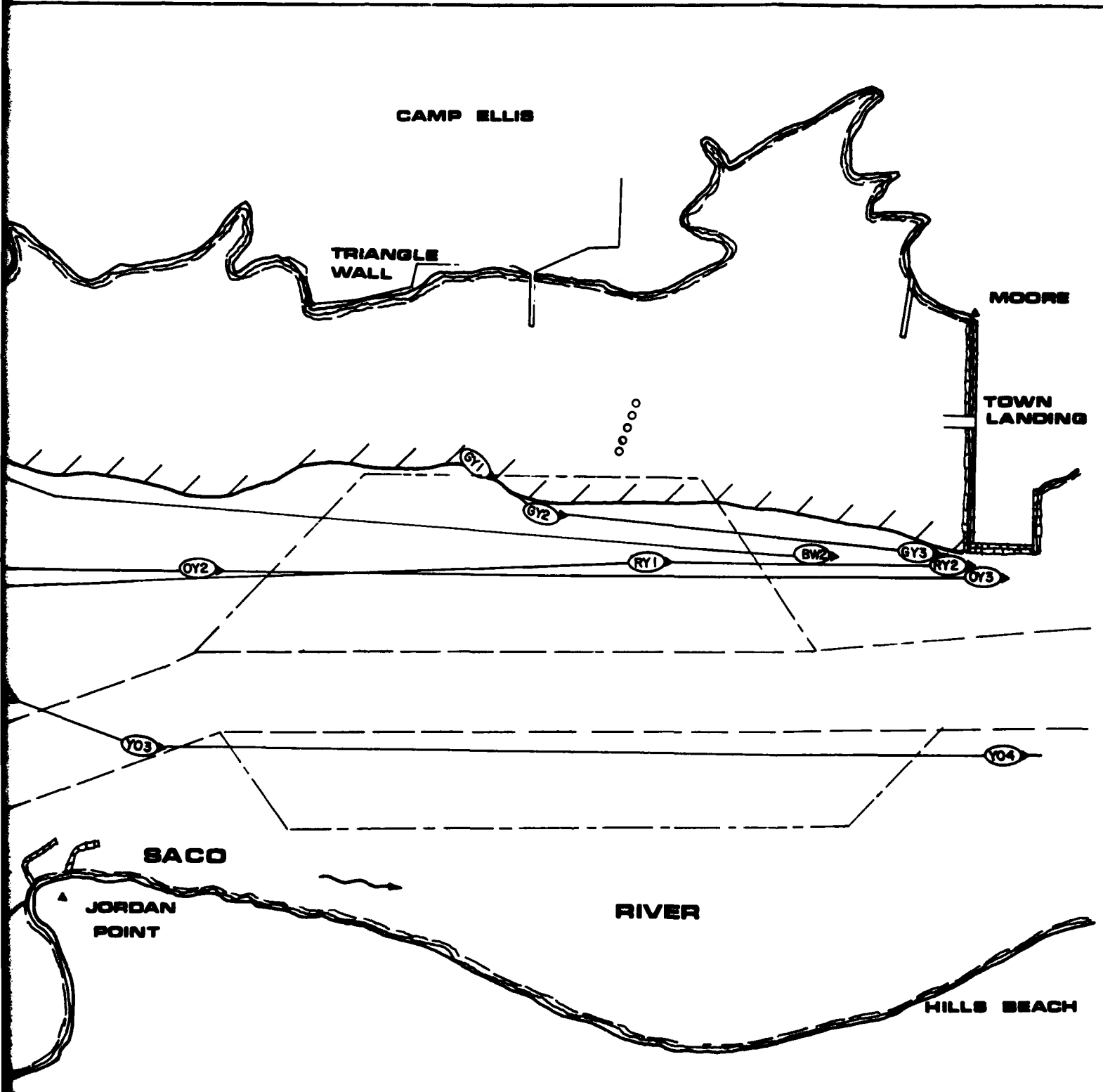
200 100 0 200 400

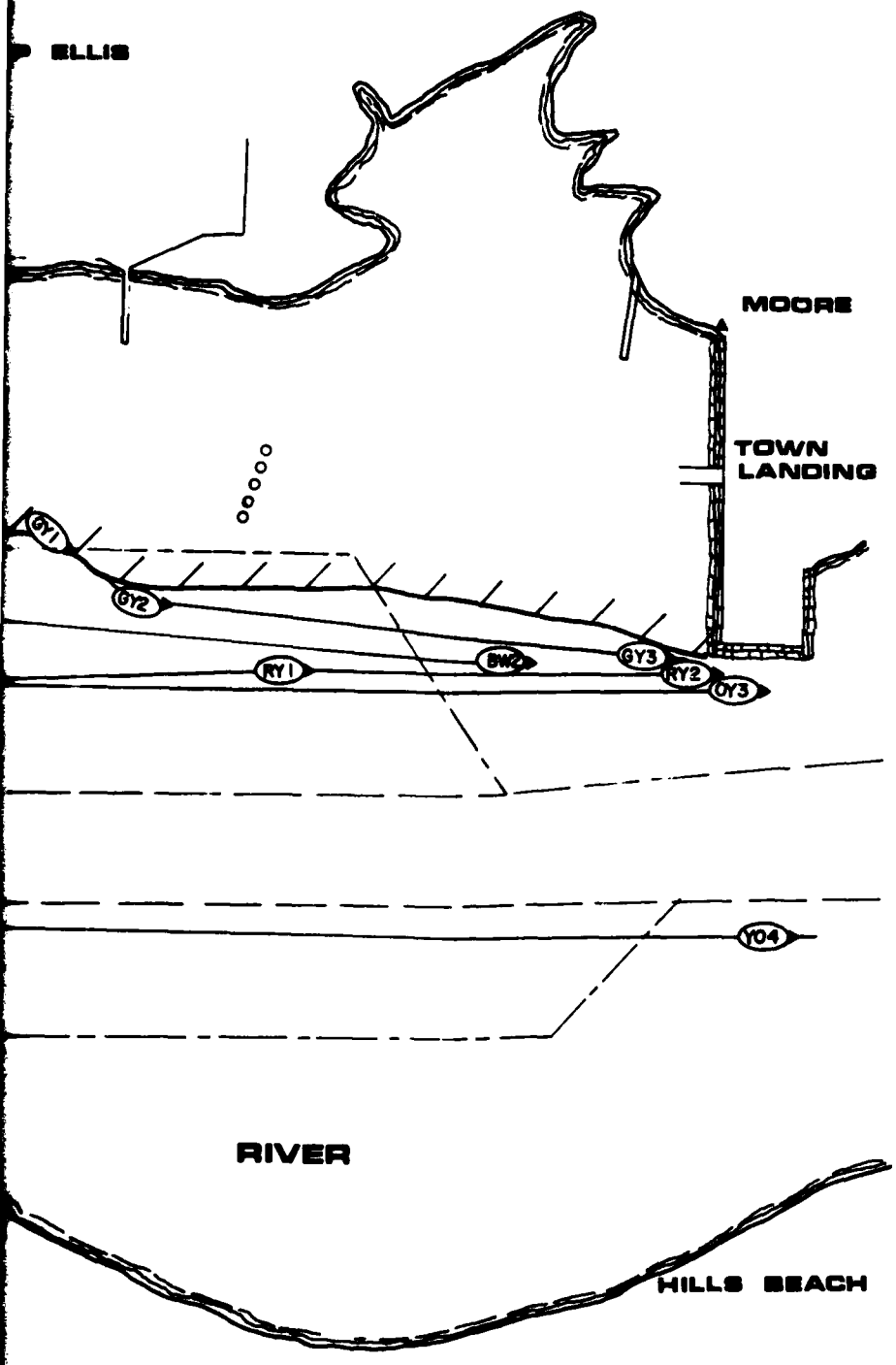
SCALE IN FEET

U.S. ARMY ENGINEER DIVISION
NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

FIGURE 4-2


TO WINDMILL POINT
(THE NARROWS)
BW1
YO1
OY1
YO2
WEATHER
AVERAGE TEMPERATURE 14 °F
AVERAGE WIND SPEED 3.0 MPH
WIND DIRECTION SW
HIGH TIDE 10:23 A.M.


CAMP ELLIS
TRIANGLE WALL
MOORE
TOWN LANDING
GY1
GY2
OY2
RY1
BW2
GY3
RY2
OY3
OY3
OY4
SACO
JORDAN POINT
RIVER
HILLS BEACH



WATER RESOURCES STUDY
SACO RIVER, SACO MAINE

ICE FORMATION AND MOVEMENT ON FEB.3,1977

LEGEND

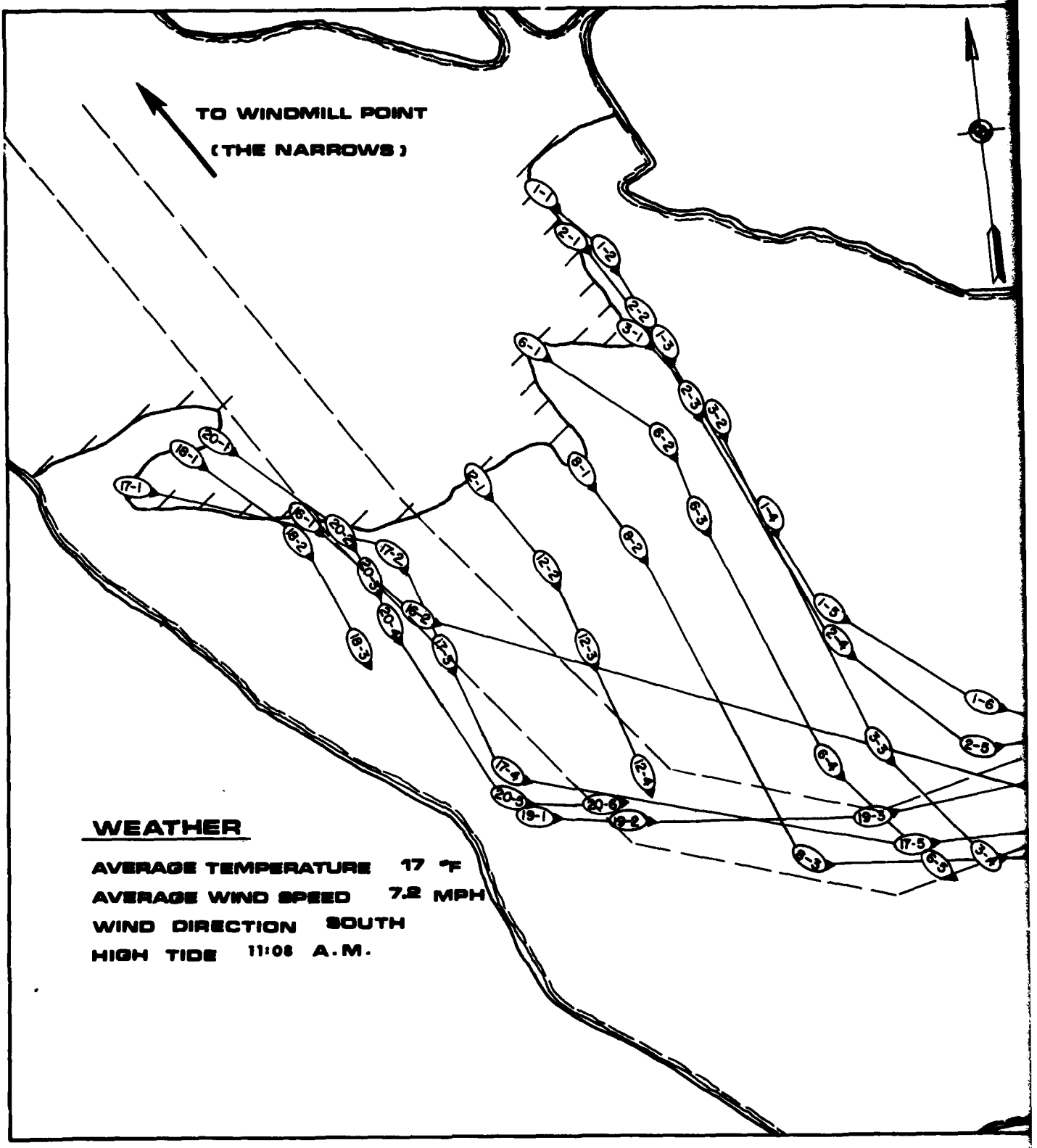
- EXISTING SHORELINE
- EXISTING CHANNEL
- EXISTING ANCHORAGE
- EXISTING PILES
- ICE FORMATION
- (23) ICE MOVEMENT DATA POINT
- △ TRIANGULATION STATION

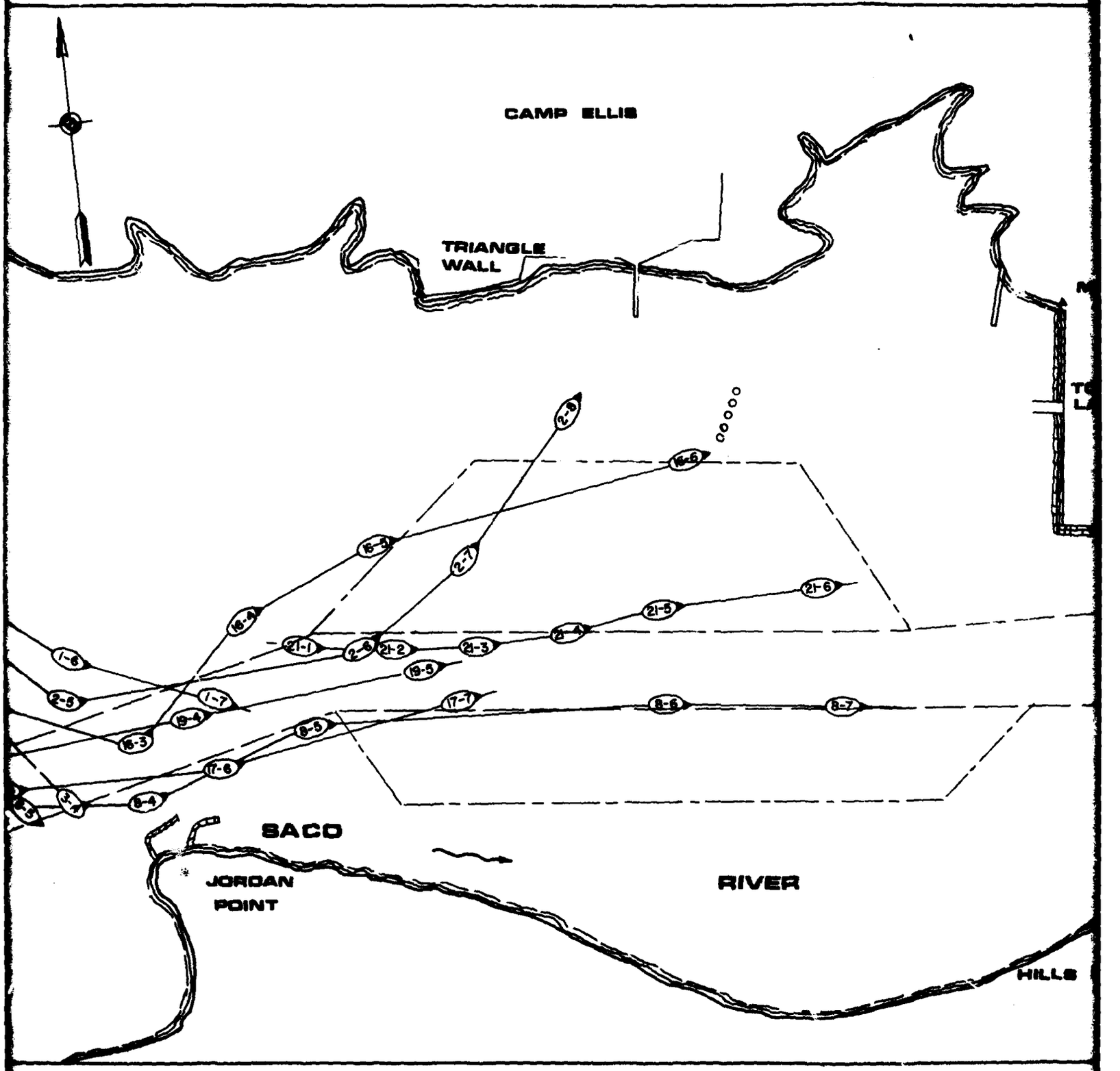
200 100 0 200 400
SCALE IN FEET

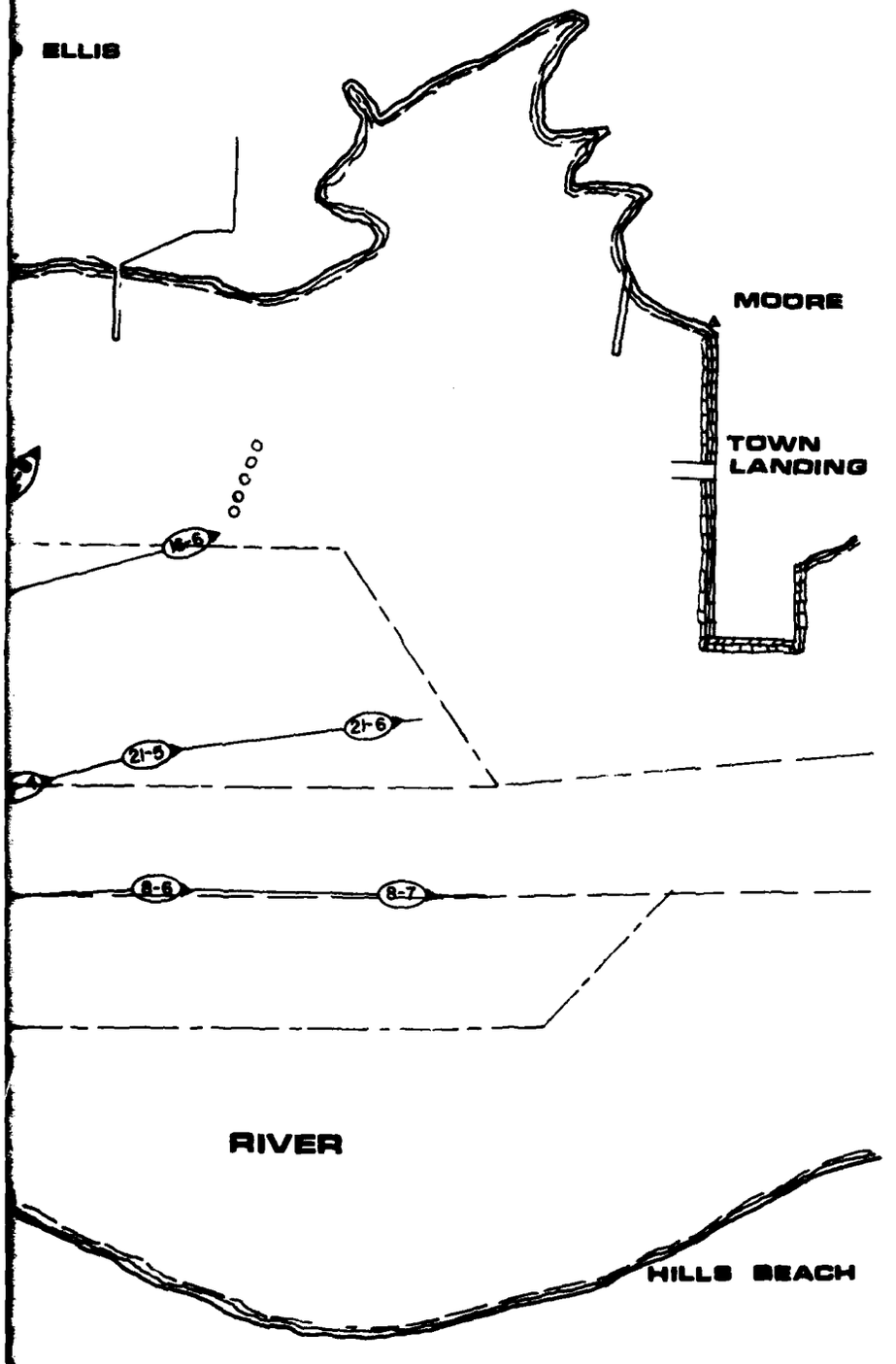
U.S. ARMY ENGINEER DIVISION
NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

FIGURE 4-3

2 1 3


TO WINDMILL POINT
(THE NARROWS)
WEATHER
AVERAGE TEMPERATURE 17 °F
AVERAGE WIND SPEED 7.2 MPH
WIND DIRECTION SOUTH
HIGH TIDE 11:08 A.M.


CAMP ELLIS
TRIANGLE WALL
SACO
JORDAN POINT
RIVER
HILLS
2-8
16-6
16-5
2-7
16-4
21-6
21-5
21-4
21-1
2-6
21-2
21-3
1-6
19-5
2-5
1-7
17-7
8-6
8-7
19-4
16-3
8-5
17-6
3-4
8-4



WATER RESOURCES STUDY
SACO RIVER, SACO MAINE

ICE FORMATION AND MOVEMENT ON FEB.18,1977

LEGEND

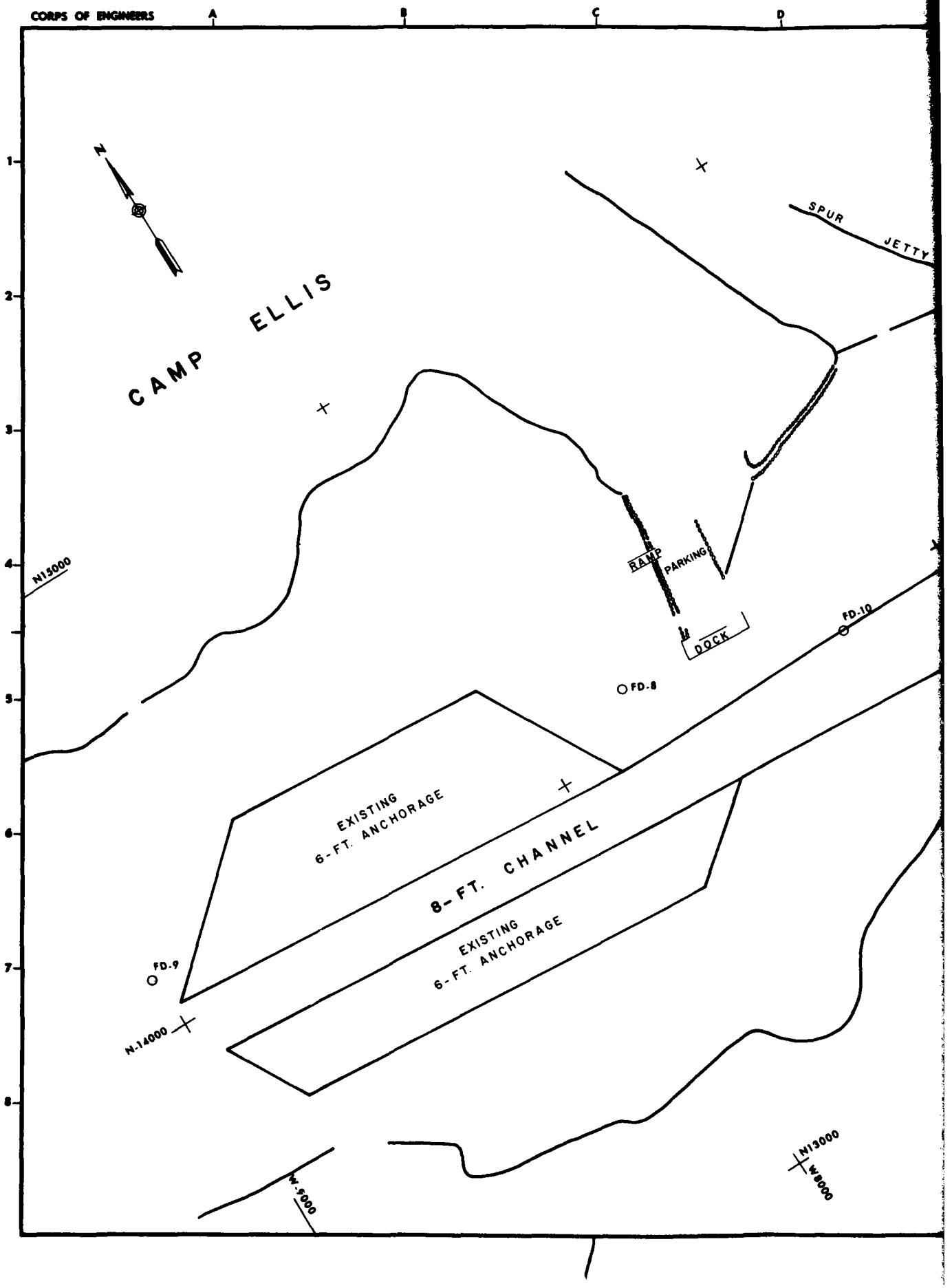
- EXISTING SHORELINE
- EXISTING CHANNEL
- EXISTING ANCHORAGE
- EXISTING PILES
- ICE FORMATION
- (23) ICE MOVEMENT DATA POINT
- △ TRIANGULATION STATION

200 100 0 200 400
SCALE IN FEET

U.S. ARMY ENGINEER DIVISION
NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

FIGURE 4-4

2 3


CORPS OF ENGINEERS
A
B
C
D
1
2
3
4
5
6
7
8
N
CAMP ELLIS
SPUR JETTY
N15000
RAMP
PARKING
DOCK
FD-10
FD-8
EXISTING
6-FT. ANCHORAGE
8-FT. CHANNEL
EXISTING
6-FT. ANCHORAGE
FD-9
N-14000
W-5000
N13000
W8000

D
E
F
G
H
U. S. ARMY
1
2
3
4
5
6
7
8
SPUR JETTY
JETTY
NORTH
SOUTH JETTY
FD-11
FD-10
DOCK
W7000
N13000
W8000
CANADA
MAINE
BANGOR
AUGUSTA
NEW HAMPSHIRE
PORTLAND
SACO RIVER
CONCORD
ATLANTIC
OCEAN
PORTSMOUTH
VT.
BOSTON
MASSACHUSETTS
HARTFORD
PROV.
CONN
R.I.
LOCATION MAP
SCALE 1"=37.5 MILES
GRAPHIC SCALES
1"=37.5MI 25 0 25 50 75MI
1"=100' 100' 0 100' 200'
SAFETY PAYS
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.
WATER RESOURCES IMPROVEMENT STUDY
CAMP ELLIS HARBOR
SACO RIVER, SACO, MAINE
LOCATION OF TEST
BORINGS
APPROVED
DATE
SCALE
SPEC. NO. NECW 53

FIGURE 4-8

SUMMARY OF TEST BORING FD-8

ELEVATION OF TOP OF BORING -3.0' MLW HAMMER WEIGHT 300 LBS.

ELEVATION OF BOTTOM OF BORING -28.0' MLW HAMMER DROP 30"

DEPTH	BLOWS PER FOOT	CLASSIFICATION OF MATERIAL
0	WEIGHT OF TOOLS AND HAMMER	GREYISH GRAVELY SAND WITH SHELL FRAGMENTS AND MARINE ODOR
	3 / 3	COARSE GREY SAND
5	5 / 3 / 4 / 5 / 5	GREY FINE SAND WITH SHELL FRAGMENTS
10	5 / 4 / 2 / 3	GREY SILTY FINE SAND WITH WOOD FIBER AND SHELL FRAGMENTS
15	4 / 2 / 2	SILTY FINE SAND WITH SHELL FRAGMENTS (SM)
	4 / 4 / 5	SILTY SAND WITH SHELL FRAGMENTS (SP-SM)
20	2 / 2 / 3 / 3 / 7	GREY SILTY FINE SAND WITH SHELL FRAGMENTS AND WOOD FIBER
25		EXTENT OF EXPLORATION AT -28.0'MLW

FIGURE 4-6

SUMMARY OF TEST BORING FD-9

ELEVATION OF TOP OF BORING -1.0'MLW HAMMER WEIGHT 300LBS

ELEVATION OF BOTTOM OF BORING -26.0'MLW HAMMER DROP 30"

DEPTH	BLOWS PER FOOT	CLASSIFICATION OF MATERIAL
0	1 2 3 3 3	GREY SAND WITH PIECES OF WOOD
5	7 7 5 7 5	COARSE GREY SAND (SP)
10		COARSE GREY SAND (SP) WITH SHELL FRAGMENTS
15		GREY SILTY MED. TO FINE SAND WITH WOOD FIBER
20		GREY SILTY MEDIUM TO FINE SAND (SP-SM)
25		EXTENT OF EXPLORATION AT -26.0'MLW

FIGURE 4-7

SUMMARY OF TEST BORING FD-10

ELEVATION OF TOP OF BORING -8.4'MLW HAMMER WEIGHT 350LBS.

ELEVATION OF BOTTOM OF BORING -38.4'MLW HAMMER DROP 18"

DEPTH	BLOWS PER FOOT	CLASSIFICATION OF MATERIAL
0	WEIGHT OF TOOLS AND HAMMER	GREYISH BROWN MED. TO FINE SAND
	2 1 2 4	GREYISH-BROWN MED. TO FINE SAND MOIST WITH SHELL FRAGMENTS AND MARINE ODOR
5	5 6 10 10 12	DARK GREY TO BROWN MED, TO FINE SAND, MOIST AND OIL STAINED WITH SHELL FRAGMENTS AND MARINE ODOR
10	8 8 12 11 14	TRACES OF GRAVEL
15	17 17 19 18 21	
20	8 8 9 12 12	MED. GREY SILTY SAND, MED. TO FINE WITH TRACES OF ORGANICS
25		

FIGURE 4-8

SUMMARY OF TEST BORING FD-10

CONTINUATION OF LOG BELOW 25 FOOT DEPTH

ELEVATION OF TOP OF BORING -8.4'MLW HAMMER WEIGHT 350LBS

ELEVATION OF BOTTOM OF BORING -38.4' HAMMER DROP 18"

DEPTH	BLOWS PER FOOT	CLASSIFICATION OF MATERIAL
25	10 12 15 17 19	GREYISH BROWN MED. TO FINE MOIST WITH TRACES OF ORGANICS
30		EXTENT OF EXPLORATION AT 30.0 FEET MLW
35		
40		
45		
50		

FIGURE 4-8 CON'T

SUMMARY OF TEST BORING FD-11

ELEVATION OF TOP OF BORING -8.6'MLW HAMMER WEIGHT 350LBS

ELEVATION OF BOTTOM OF BORING -38.6'MLW HAMMER DROP 18"

DEPTH	BLOWS PER FOOT	CLASSIFICATION OF MATERIAL
0	WT. OF TOOLS AND HAMMER	
0.8	1	GREYISH BROWN MED. TO FINE SAND, MOIST WITH TRACES OF SHELL FRAGMENTS
	2	
	4	
5	4	
	7	
	12	
	12	
	15	
	16	
10	8	
	10	
	10	
	12	
15	12	
	12	GREY-BROWN MEDIUM TO FINE SAND WITH TRACES OF SHELL FRAGMENTS, ORGANICS, AND PIECES BARK
	13	
	8	
	10	
20	9	
	7	
	7	
	8	
	10	
25	9	

FIGURE 4-9

SUMMARY OF TEST BORING FD-11

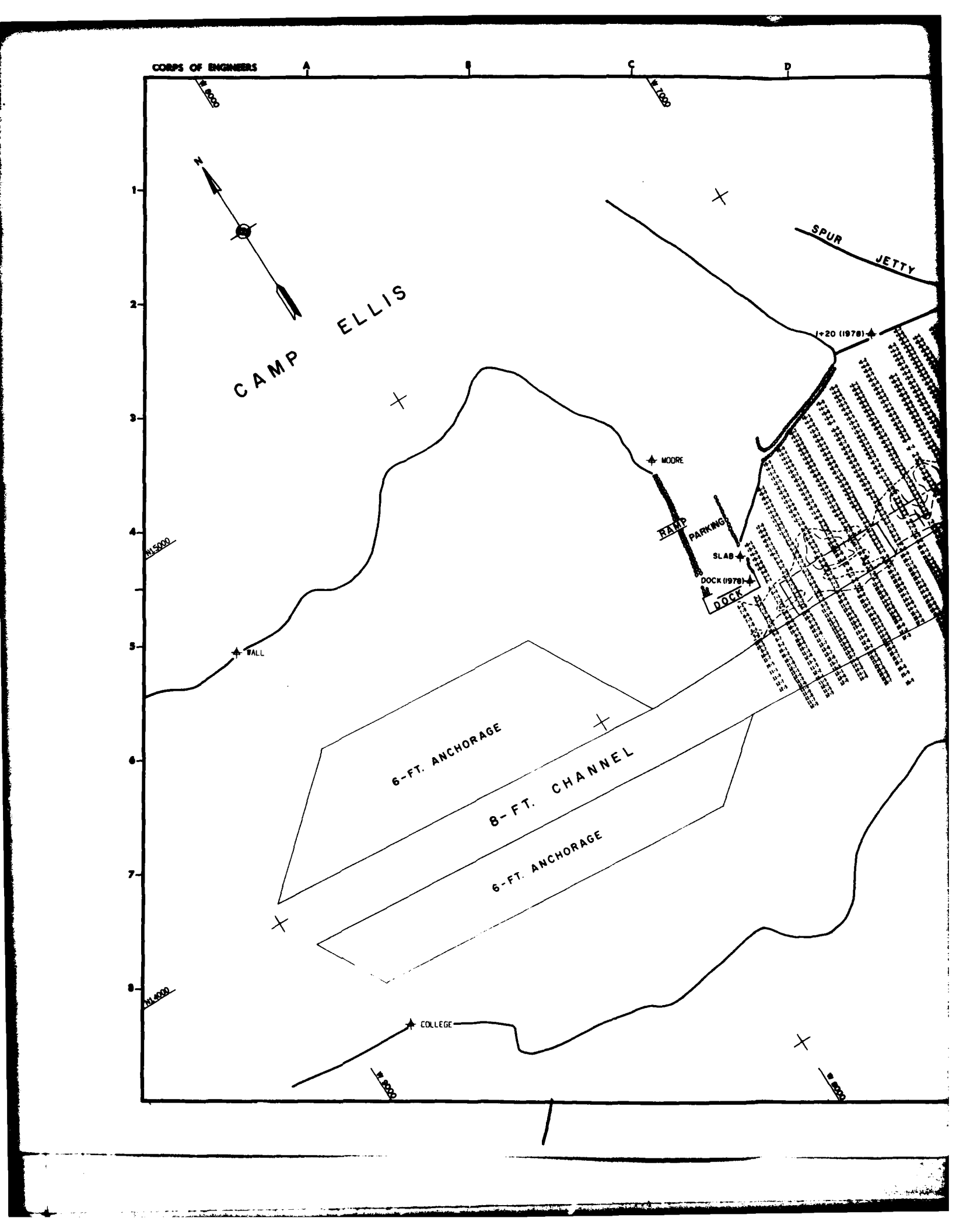
CONTINUATION OF LOG BELOW 25 FOOT DEPTH

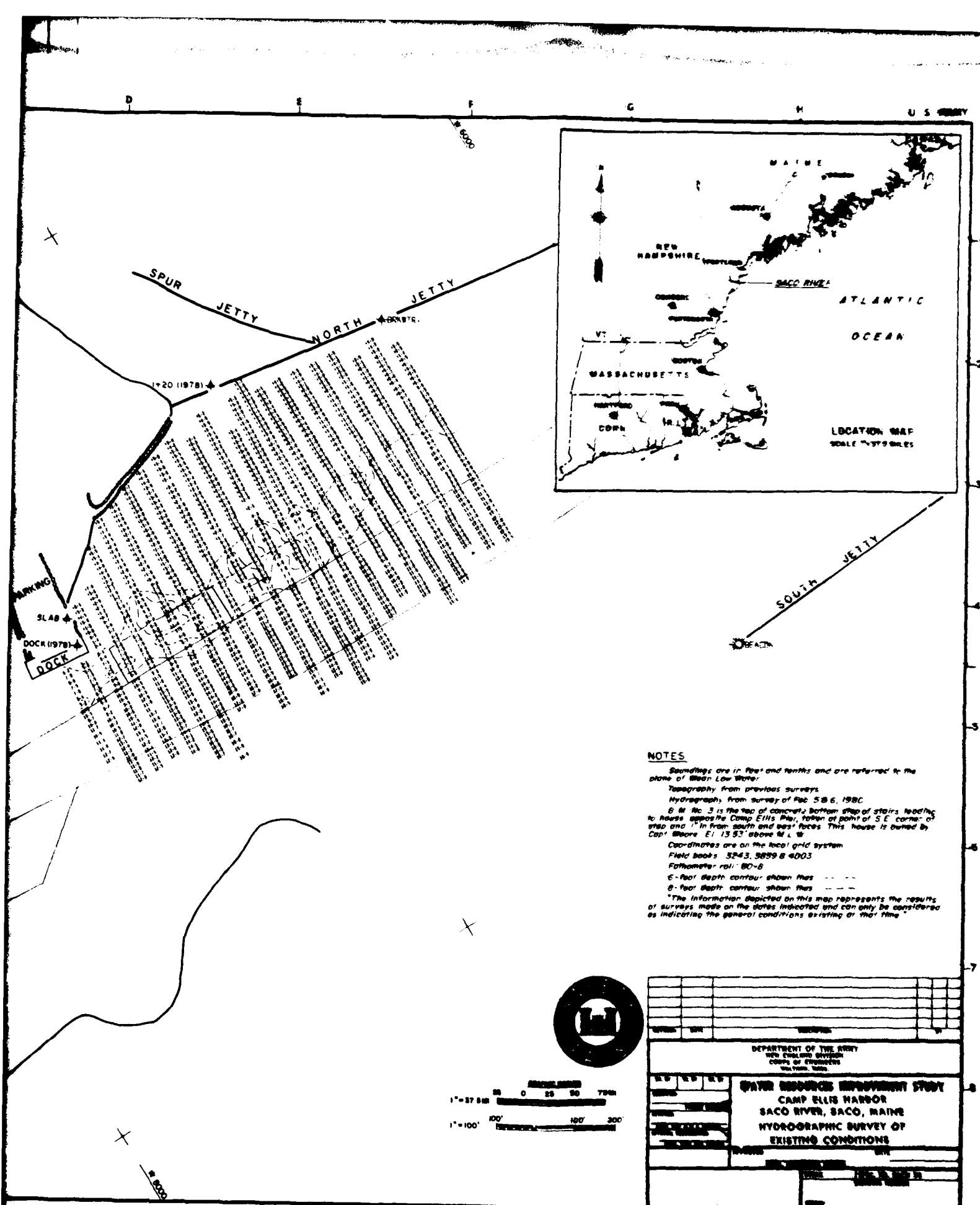
ELEVATION OF TOP OF BORING -8.6'MLW HAMMER WEIGHT 350 LBS

ELEVATION OF BOTTOM OF BORING -38.6'MLW HAMMER DROP 18"

DEPTH	BLOWS PER FOOT	CLASSIFICATION OF MATERIAL
25	12 12 12 14 14	GREYISH BROWN SAND MOIST WITH SHELL FRAGMENTS, TRACES OF ORGANICS, AND PIECES OF BARK
30		EXTENT OF EXPLORATION AT 30.0 FEET MLW
35		
40		
45		
50		

FIGURE 4-9 CON'T


CORPS OF ENGINEERS
A
B
C
D
1
2
3
4
5
6
7
8
N 9000
N 7000
N 5000
N 4000
CAMP ELLIS
SPUR JETTY
+20 (1978)
MOORE
RAMP
PARKING
SLAB
DOCK (1978)
DOCK
WALL
6-FT. ANCHORAGE
8-FT. CHANNEL
6-FT. ANCHORAGE
COLLEGE



NOTES

Soundings are in feet and tenths and are referred to the plane of Mean Low Water

Topography from previous surveys

Hydrography from survey of Dec 5 & 6, 1980

B M No 3 is the top of concrete bottom step of stairs leading to house opposite Camp Ellis Pier, taken at point of S E corner of step and 1' in from south and west faces This house is owned by Capt Moore El 13 53' above M L W

Coordinates are on the local grid system

Field books 5243, 5859 & 4003

Fathometer roll 80-8

6-foot depth contour shown thus - - - -

8-foot depth contour shown thus — — —

"The information depicted on this map represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time"

1"=37.5m 50 0 25 50 75m

1"=100' 100' 100' 200'

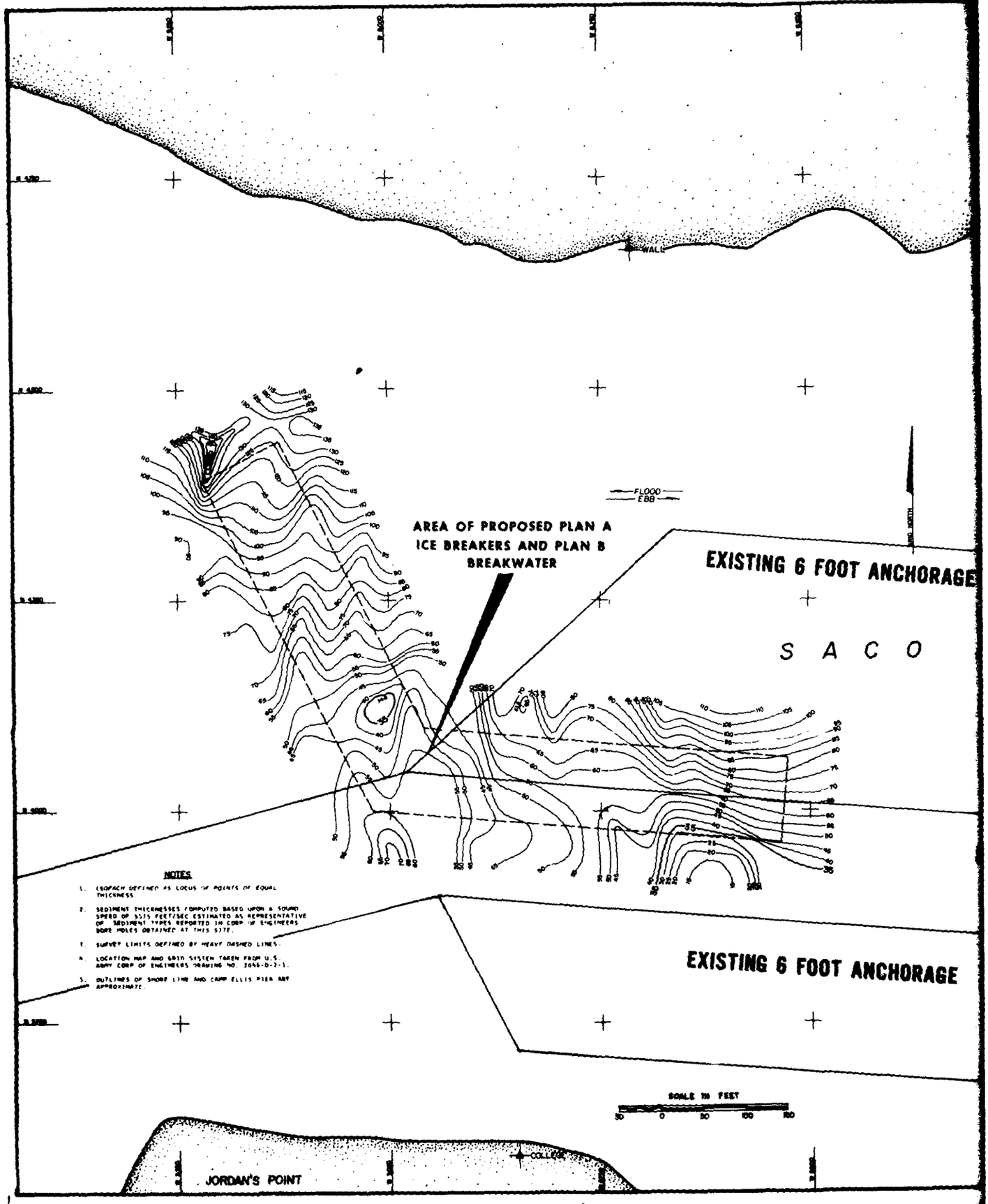
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

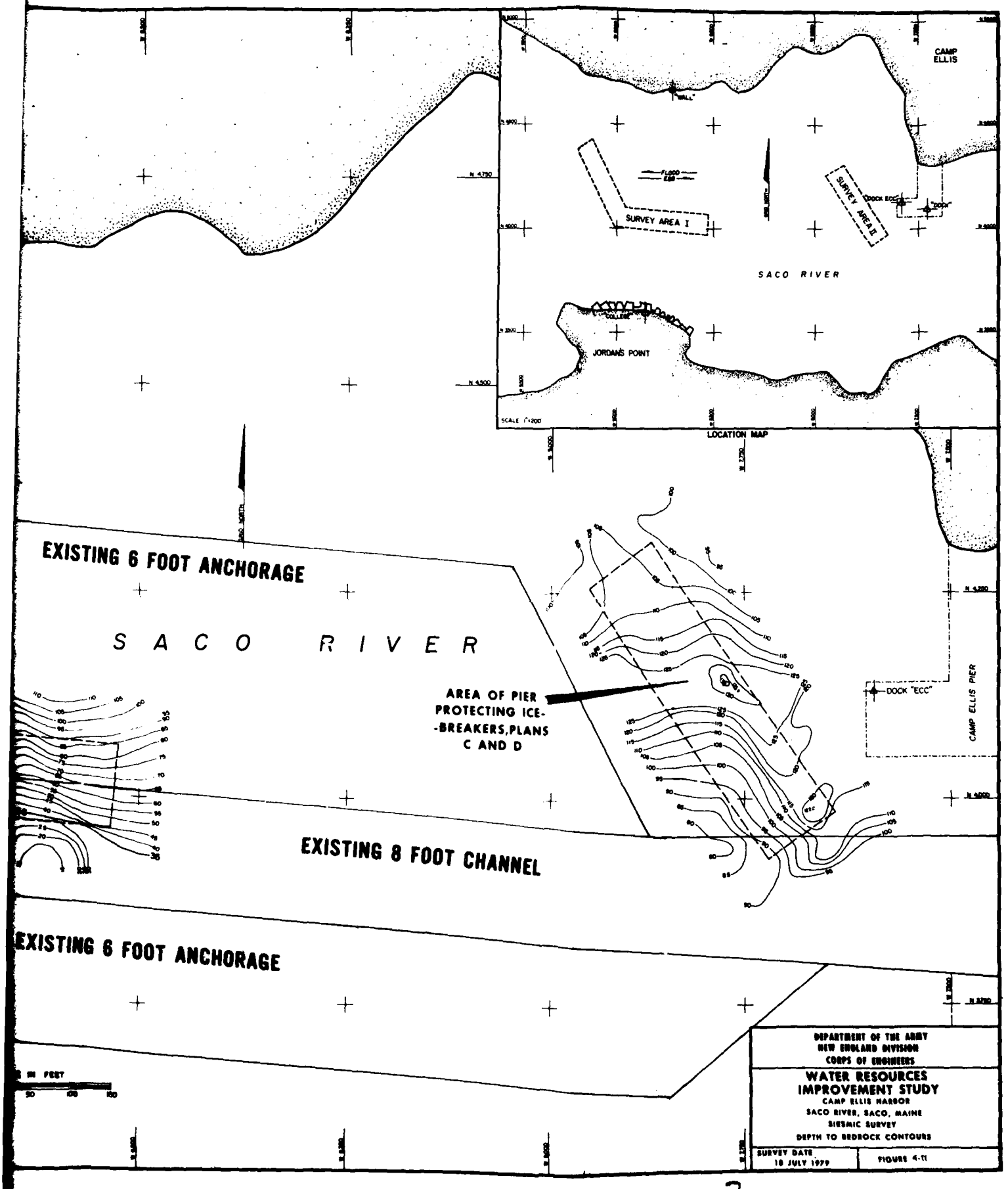
WATER RESOURCES IMPROVEMENT STUDY
CAMP ELLIS HARBOR
SACO RIVER, SACO, MAINE
HYDROGRAPHIC SURVEY OF
EXISTING CONDITIONS

FIGURE A-10

1

2


AREA OF PROPOSED PLAN A
ICE BREAKERS AND PLAN B
BREAKWATER
EXISTING 6 FOOT ANCHORAGE
S A C O
EXISTING 6 FOOT ANCHORAGE
FLOOD
EBB
JORDAN'S POINT
SCALE IN FEET
NOTES
1. ISOPACH DEFINED AS LOCUS OF POINTS OF EQUAL THICKNESS
2. SEDIMENT THICKNESSES COMPUTED BASED UPON A SOUND SPEED OF 5175 FEET/SEC ESTIMATED AS REPRESENTATIVE OF SEDIMENT TYPES REPORTED IN CORP OF ENGINEERS BORE HOLES OBTAINED AT THIS SITE.
3. SURVEY LIMITS DEFINED BY HEAVY DASHED LINES.
4. LOCATION MAP AND GRID SYSTEM TAKEN FROM U.S. ARMY CORP OF ENGINEERS DRAWING NO. 2046-D-7-1.
5. OUTLINES OF SHORE LINE AND CAMP ELLIS PIER ARE APPROXIMATE.



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS

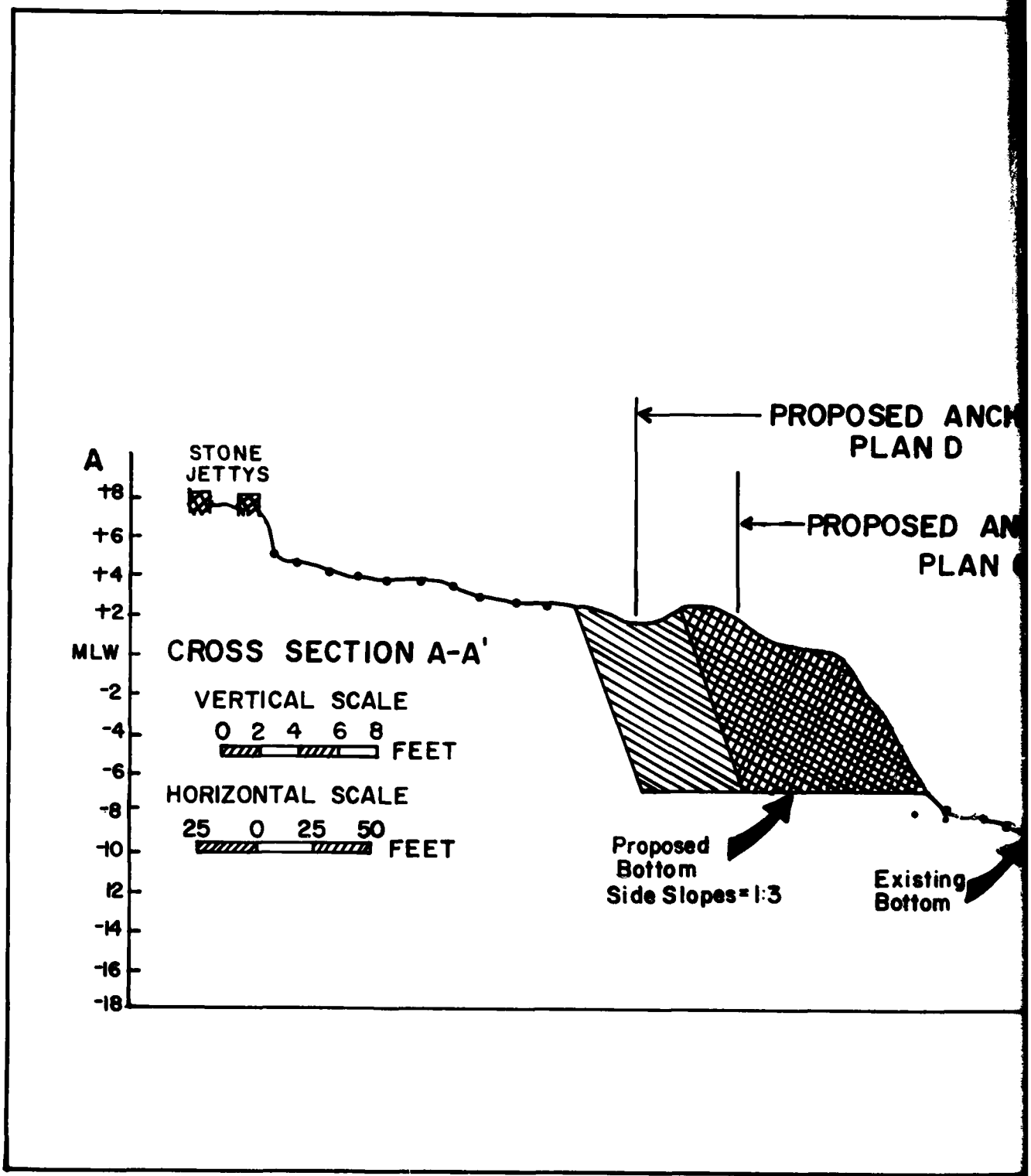
WATER RESOURCES IMPROVEMENT STUDY
CAMP ELLIS HARBOR
SACO RIVER, SACO, MAINE
SEISMIC SURVEY
DEPTH TO BEDROCK CONTOURS

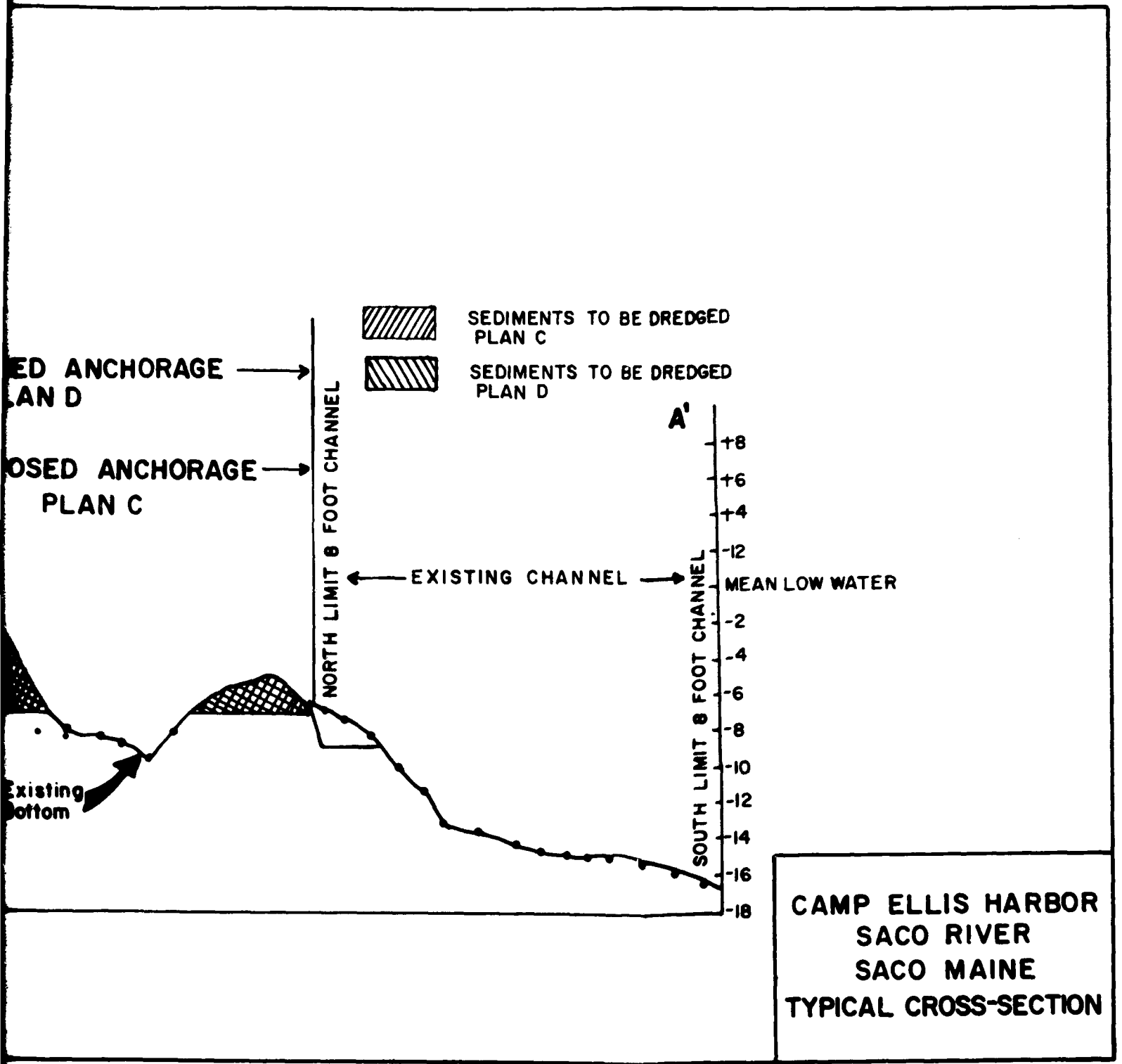
SURVEY DATE
18 JULY 1979

FIGURE 4-11

N

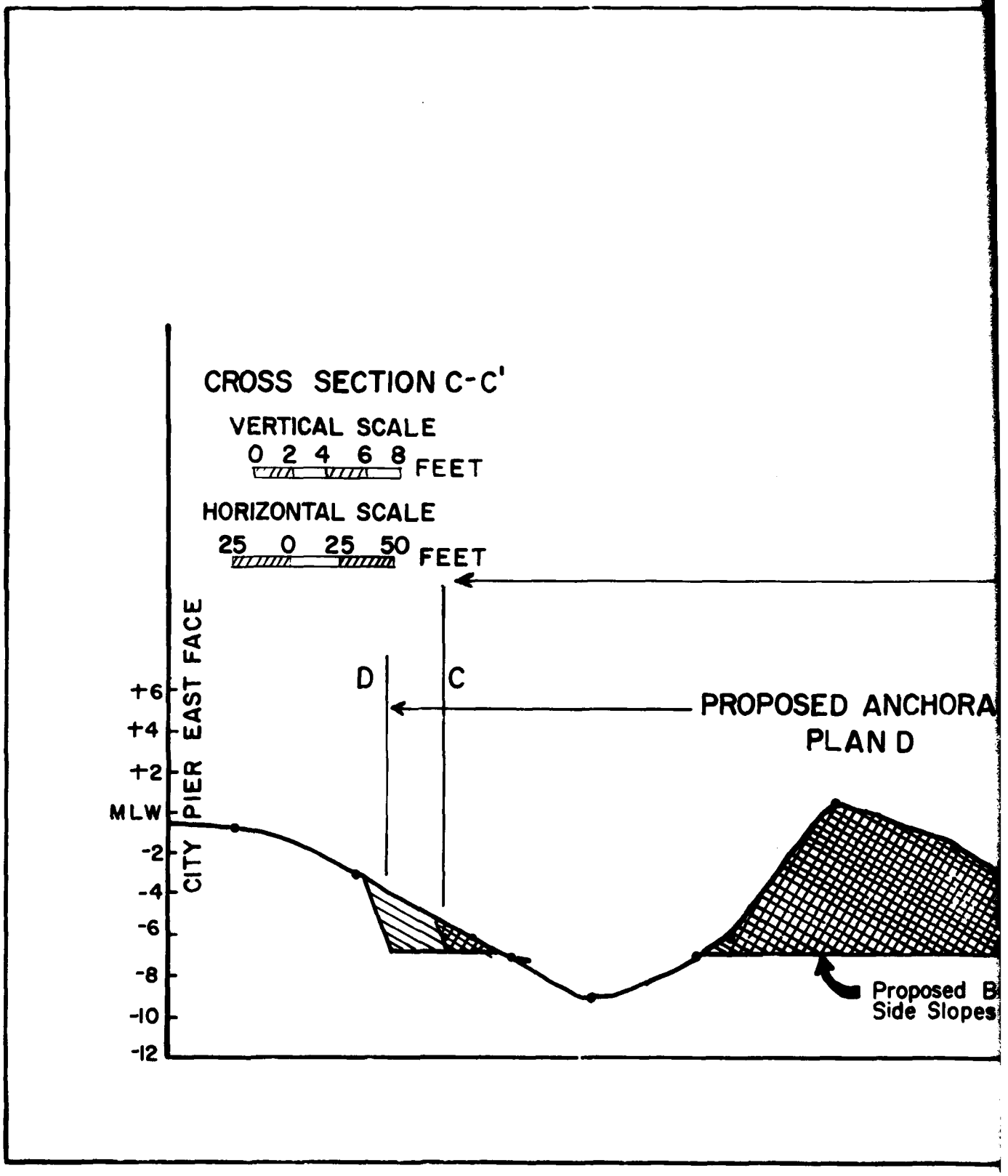
2

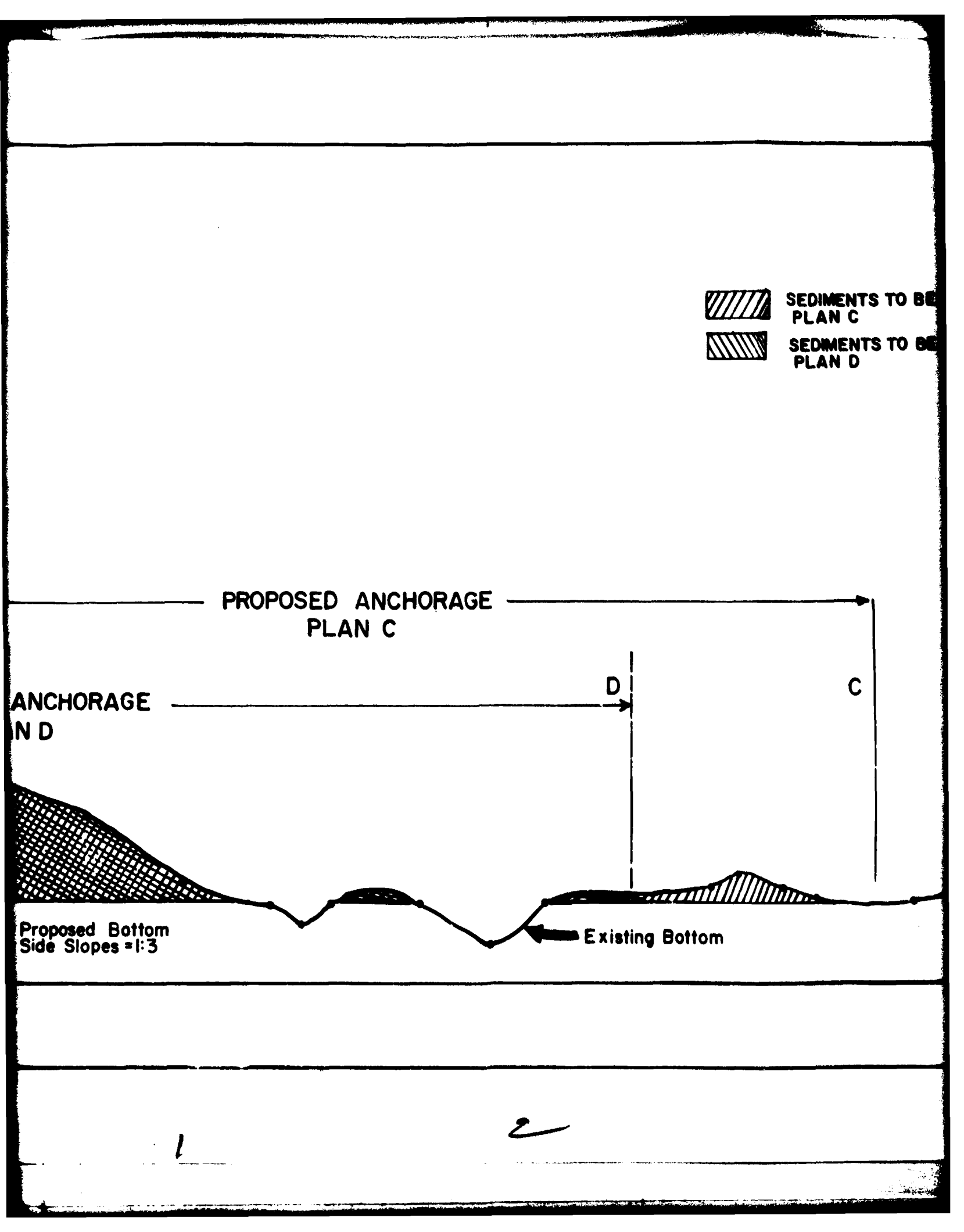

PROPOSED ANCH
PLAN D
PROPOSED AN
PLAN
A
STONE
JETTYS
+8
+6
+4
+2
MLW
-2
-4
-6
-8
-10
12
-14
-16
-18
CROSS SECTION A-A'
VERTICAL SCALE
0 2 4 6 8
FEET
HORIZONTAL SCALE
25 0 25 50
FEET
Proposed
Bottom
Side Slopes = 1:3
Existing
Bottom



CAMP ELLIS HARBOR
SACO RIVER
SACO MAINE
TYPICAL CROSS-SECTION

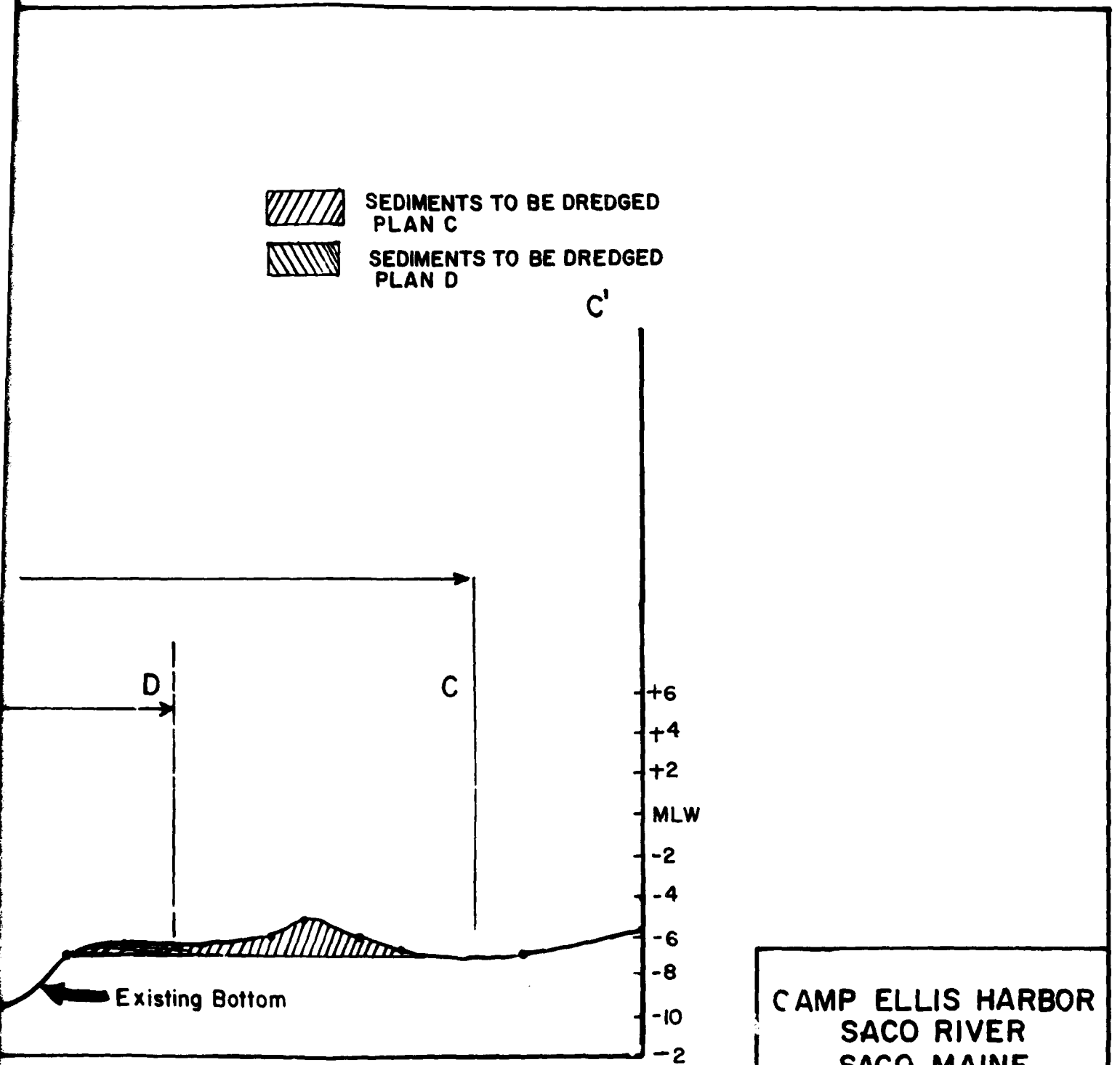
FIGURE 4-12


CROSS SECTION C-C'
VERTICAL SCALE
0 2 4 6 8 FEET
HORIZONTAL SCALE
25 0 25 50 FEET
PIER EAST FACE
CITY
+6
+4
+2
MLW
-2
-4
-6
-8
-10
-12
D
C
PROPOSED ANCHORA
PLAN D
Proposed B
Side Slopes


SEDIMENTS TO BE
PLAN C
SEDIMENTS TO BE
PLAN D
PROPOSED ANCHORAGE
PLAN C
ANCHORAGE
N D
D
C
Proposed Bottom
Side Slopes = 1:3
Existing Bottom

1

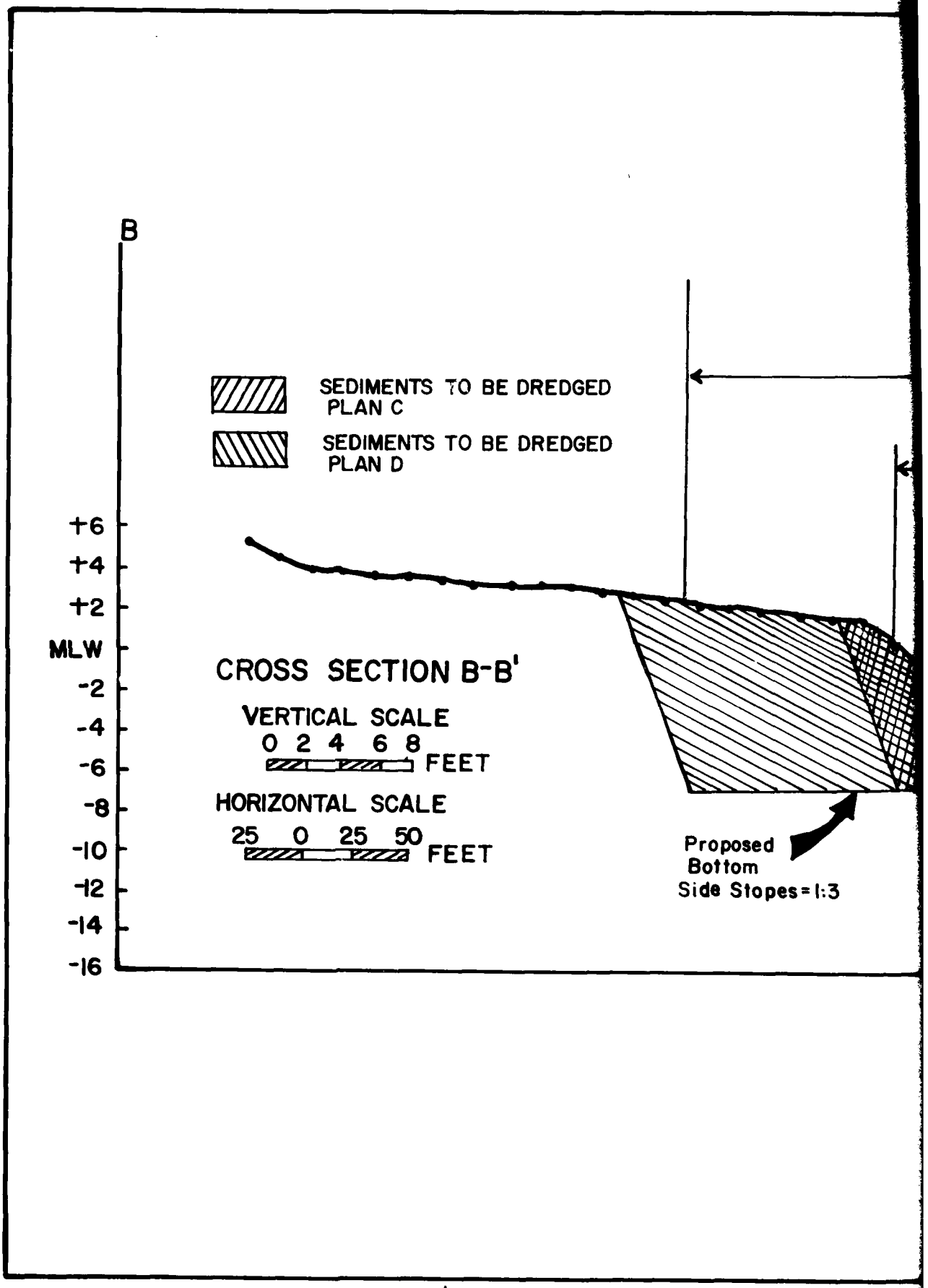
2

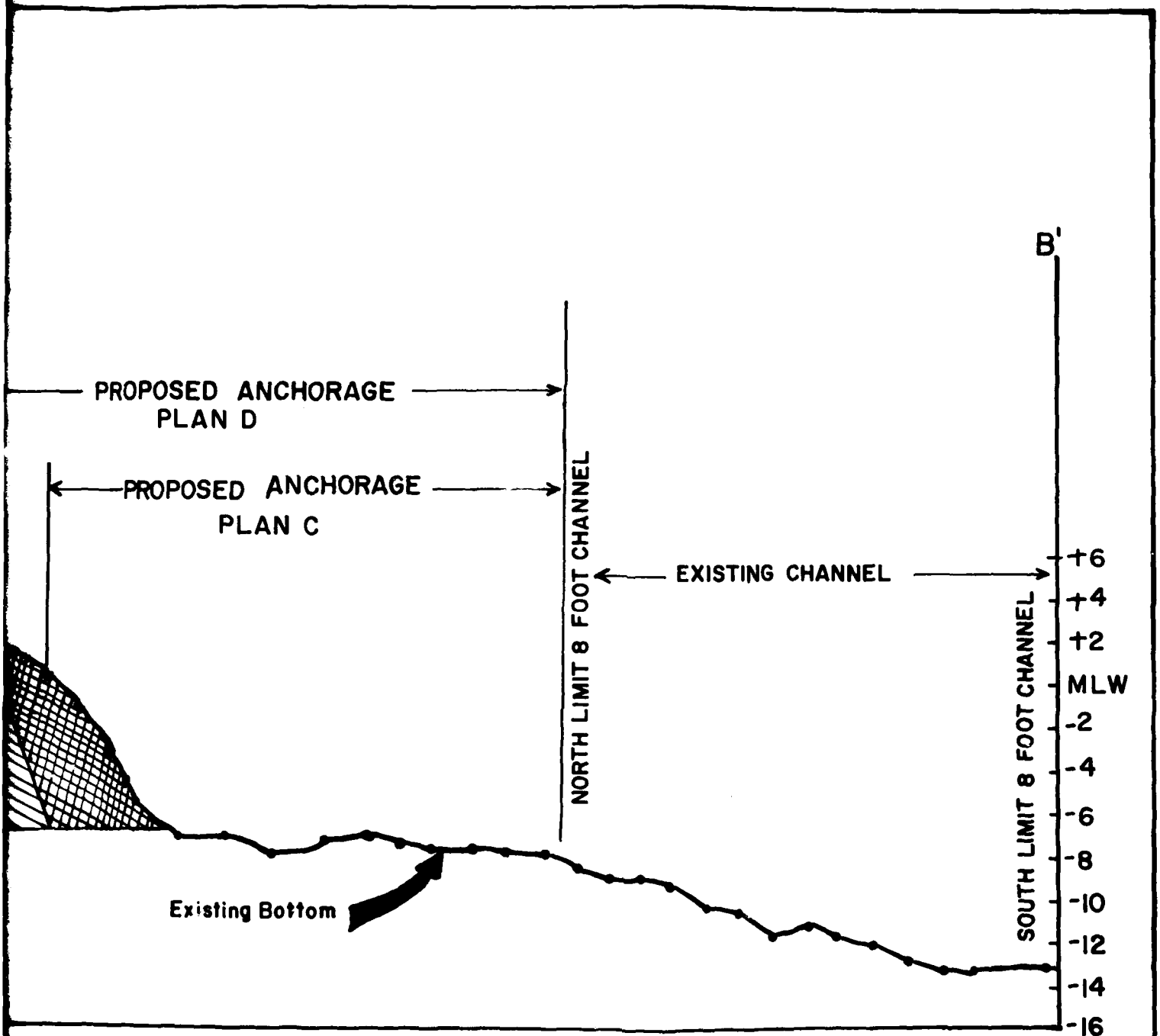


CAMP ELLIS HARBOR
SACO RIVER
SACO MAINE
TYPICAL CROSS-SECTION

FIGURE 4-13

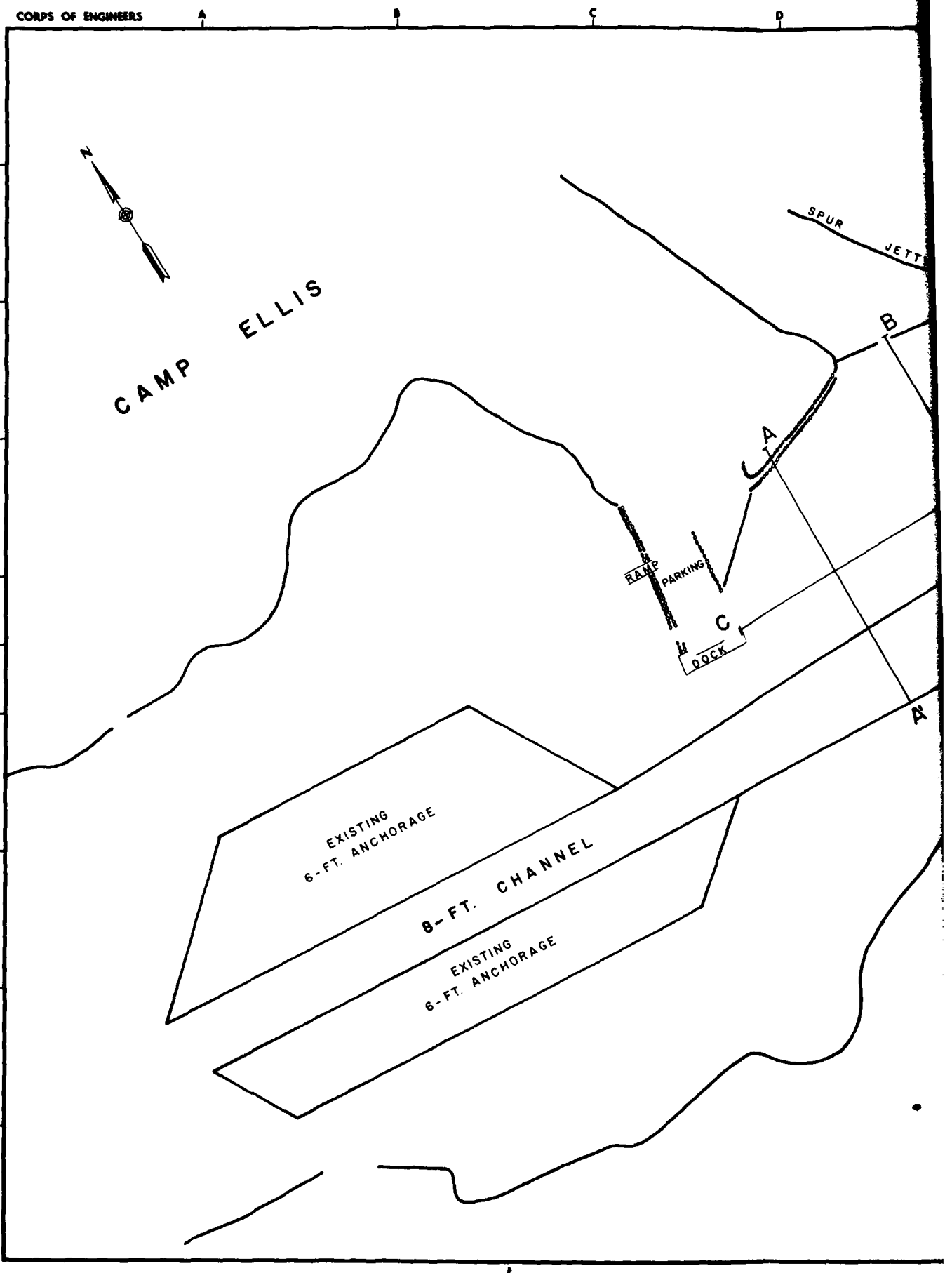
2 1 3

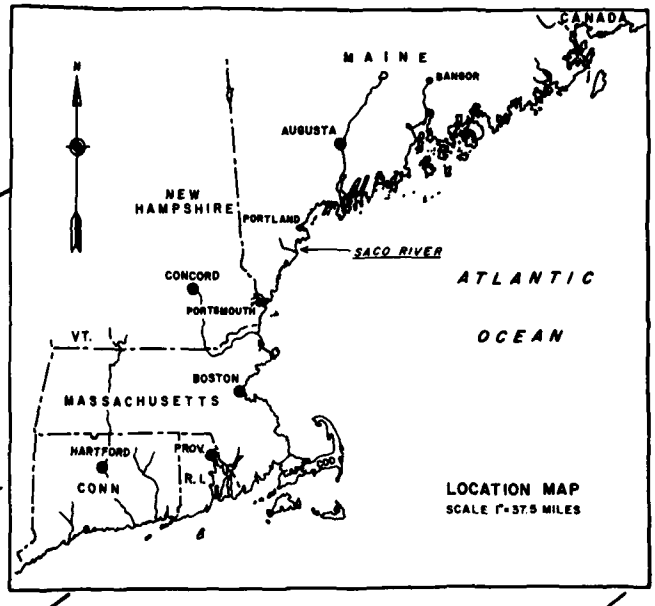

B
SEDIMENTS TO BE DREDGED
PLAN C
SEDIMENTS TO BE DREDGED
PLAN D
+6
+4
+2
MLW
-2
-4
-6
-8
-10
-12
-14
-16
CROSS SECTION B-B'
VERTICAL SCALE
0 2 4 6 8
FEET
HORIZONTAL SCALE
25 0 25 50
FEET
Proposed
Bottom
Side Slopes=1:3



CAMP ELLIS HARBOR
SACO RIVER
SACO MAINE
TYPICAL CROSS-SECTION

FIGURE 4-14


CORPS OF ENGINEERS
A
B
C
D
1
2
3
4
5
6
7
8
N
CAMP ELLIS
SPUR JETT
B
A
A'
RAMP
PARKING
C
DOCK
EXISTING
6-FT. ANCHORAGE
8-FT. CHANNEL
EXISTING
6-FT. ANCHORAGE



SPUR JETTY
JETTY
NORTH
SOUTH JETTY
A
A'
B
B'
C
C'
DOCK

GRAPHIC SCALES
1"=37.5MI 25 0 25 50 75MI
1"=100' 100' 0 100' 200'

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

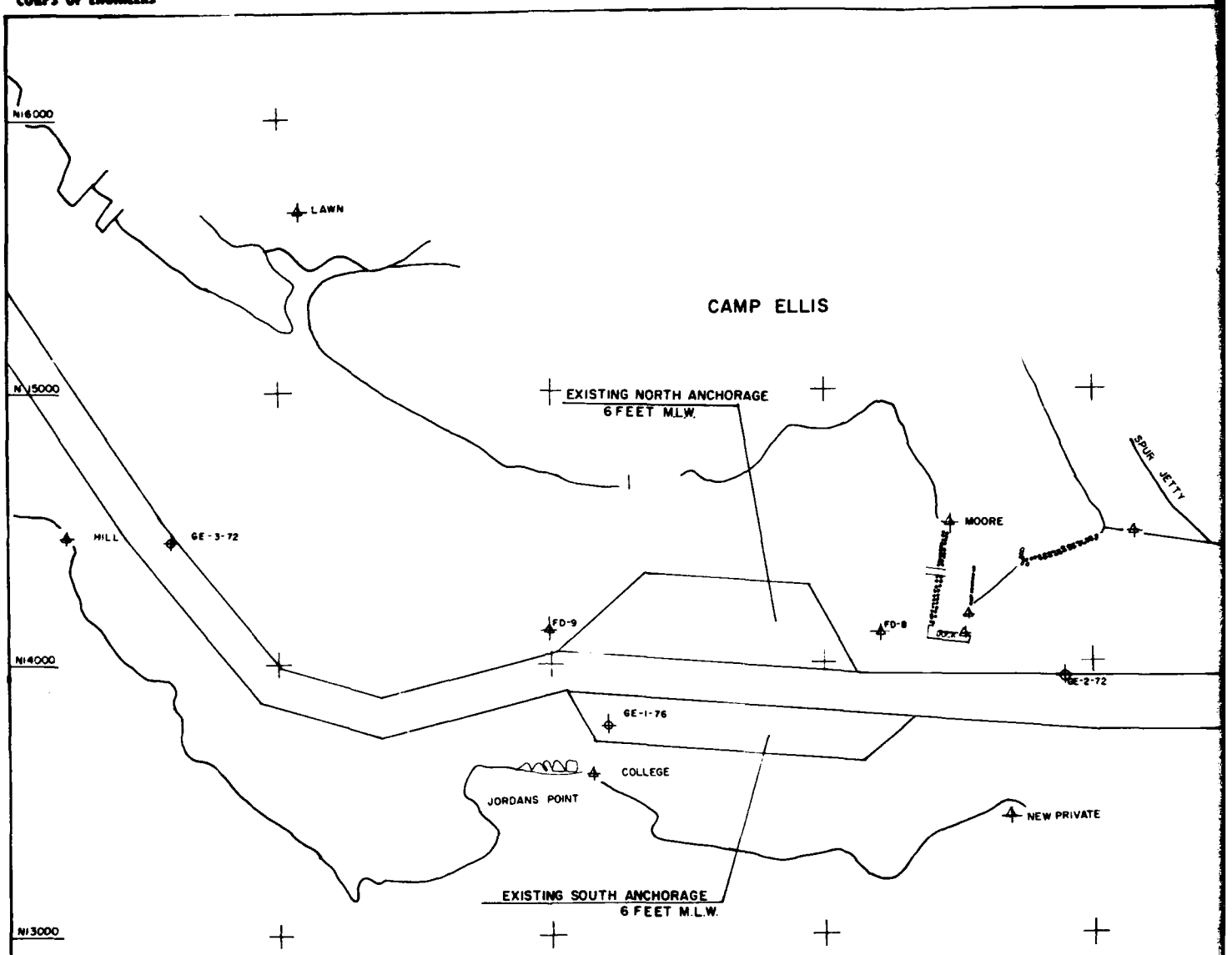
WATER RESOURCES IMPROVEMENT STUDY
CAMP ELLIS HARBOR
SACO RIVER, SACO, MAINE
LOCATIONS OF
TYPICAL CROSS SECTIONS

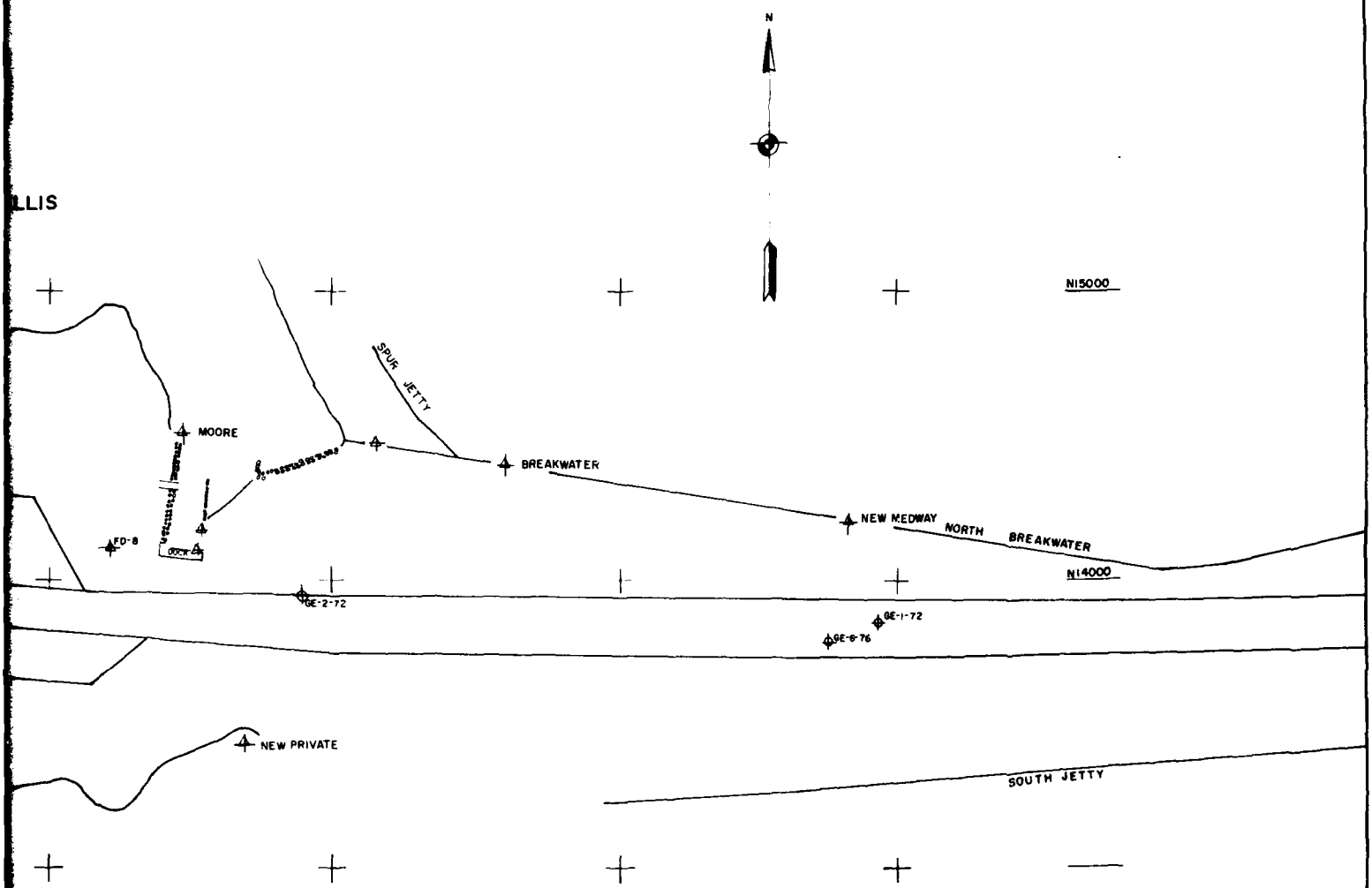
DES. BY | DR. BY | CK. BY
DESIGNED
DRAWN
TRACED
CHK. DES. & DR.
APPROVED RECOMMENDED
CHIEF, E & D BR.
APPROVED DATE
CHIEF, ENGINEERING DIV.
SCALE SPEC. NO. DACW 33
DRAWING NUMBER
SHEET

FIGURE 4-15

1 2

CORPS OF ENGINEERS



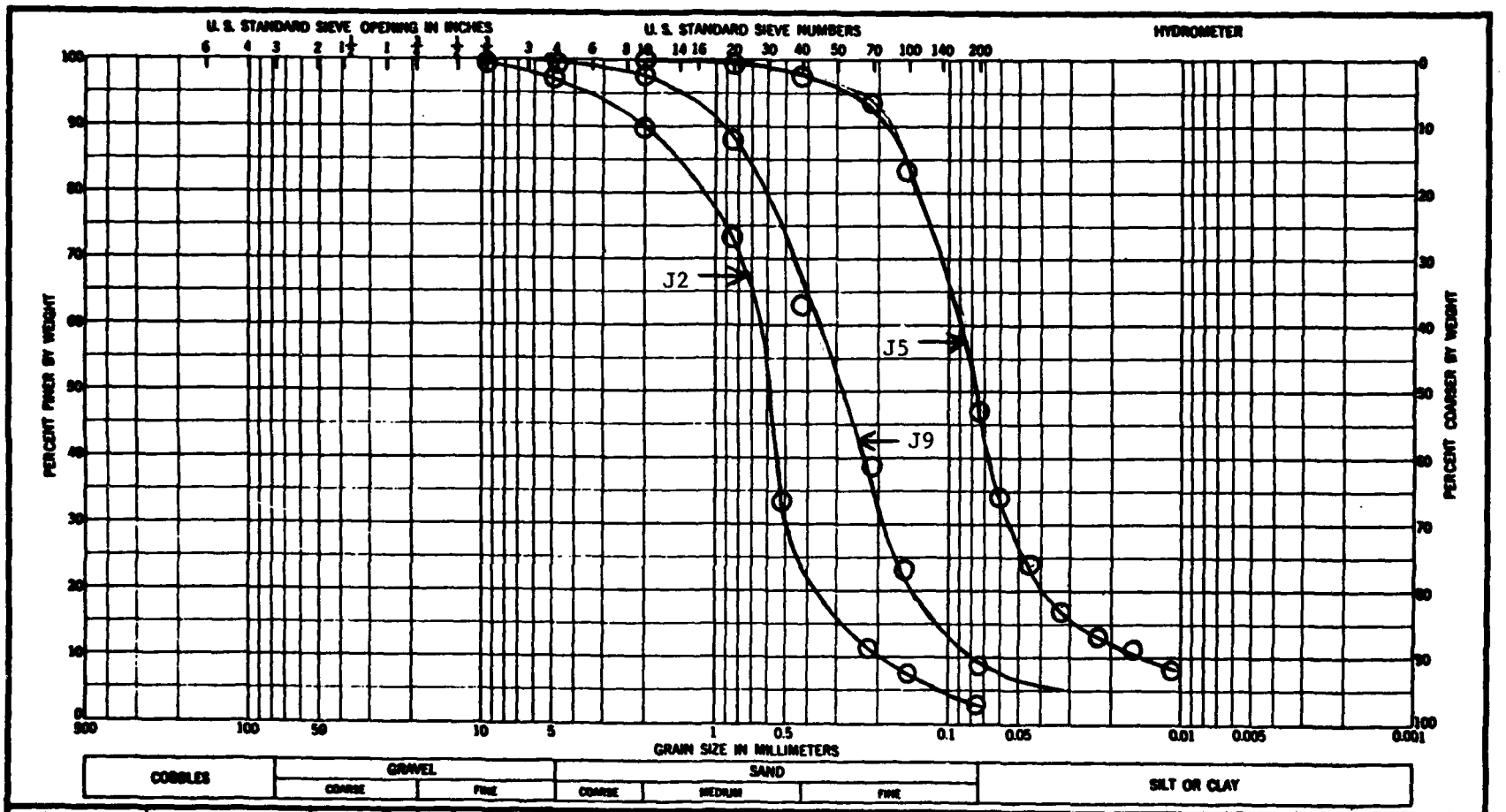


GRAPHIC SCALES
1" = 200'-0"
200' 0 200' 400'

WATER RESOURCES IMPROVEMENT STUDY
CAMP ELLIS HARBOR
SACO RIVER, SACO MAINE
SAMPLING LOCATIONS
FOR GRAIN SIZE ANALYSIS

FIGURE 4-16

SIEVE - GRAIN SIZE ANALYSIS



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
J2	3.0-5.0'	SAND (SP)				
J5	10.0-14.0'	SILTY SAND (SM)				
J9	17.0-20.0'	SILTY SAND (SP-SM)				

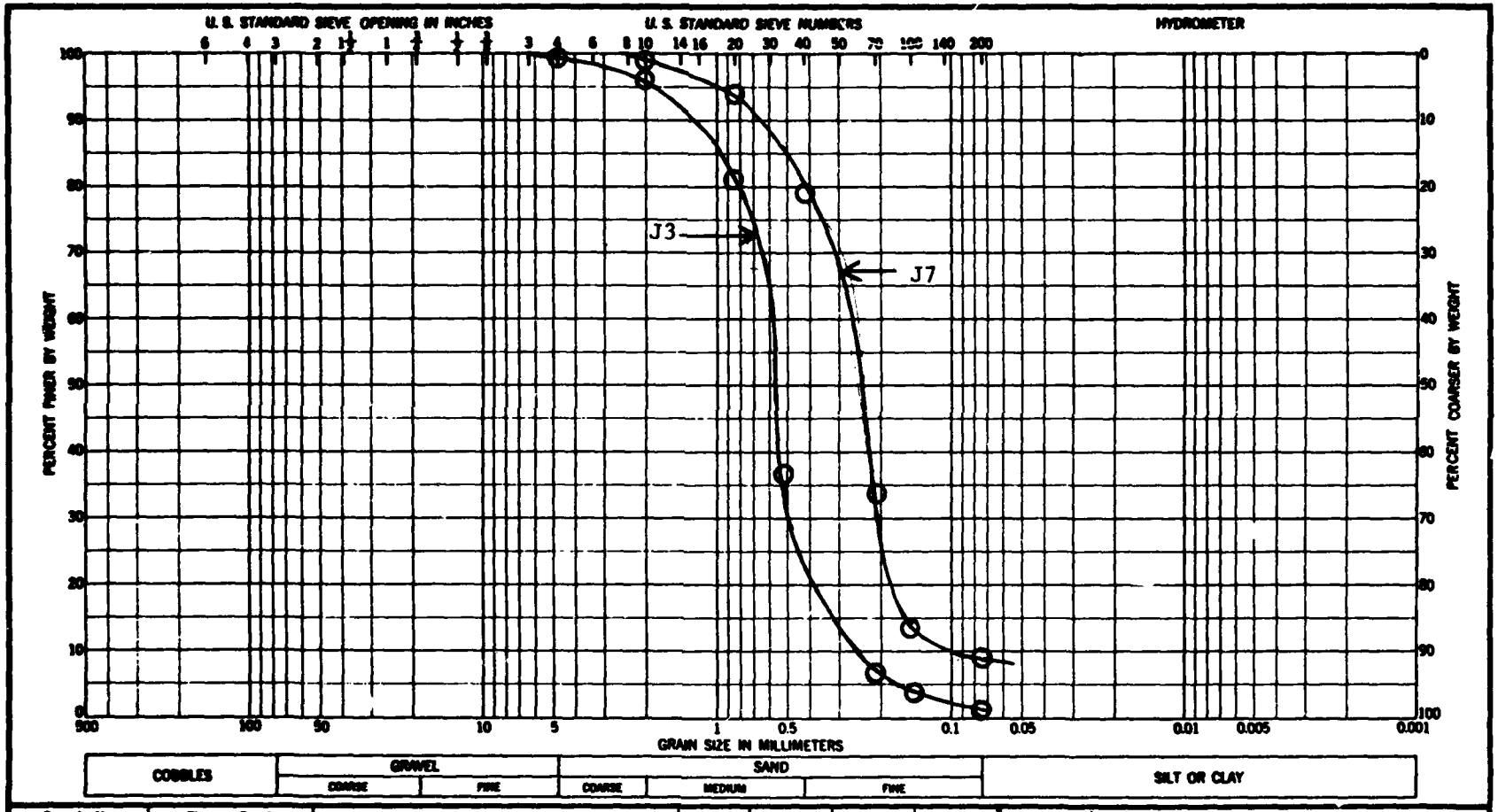
GRADATION CURVES

Project: CAMP ELLIS HARBOR
SACO RIVER, SACO, MAINE
Area:
Boring No.: FD-8
Date: OCTOBER 1979

ENG FORM 1 MAY 68 2087

FIGURE 4-17

SIEVE - GRAIN SIZE ANALYSIS



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
J3	5.0-10'	SAND (SP)				
J7	15.0-20.0'	SILTY SAND (SP-SM)				

GRADATION CURVES

Project: CAMP ELLIS HARBOR
SACO RIVER, SACO, MAINE

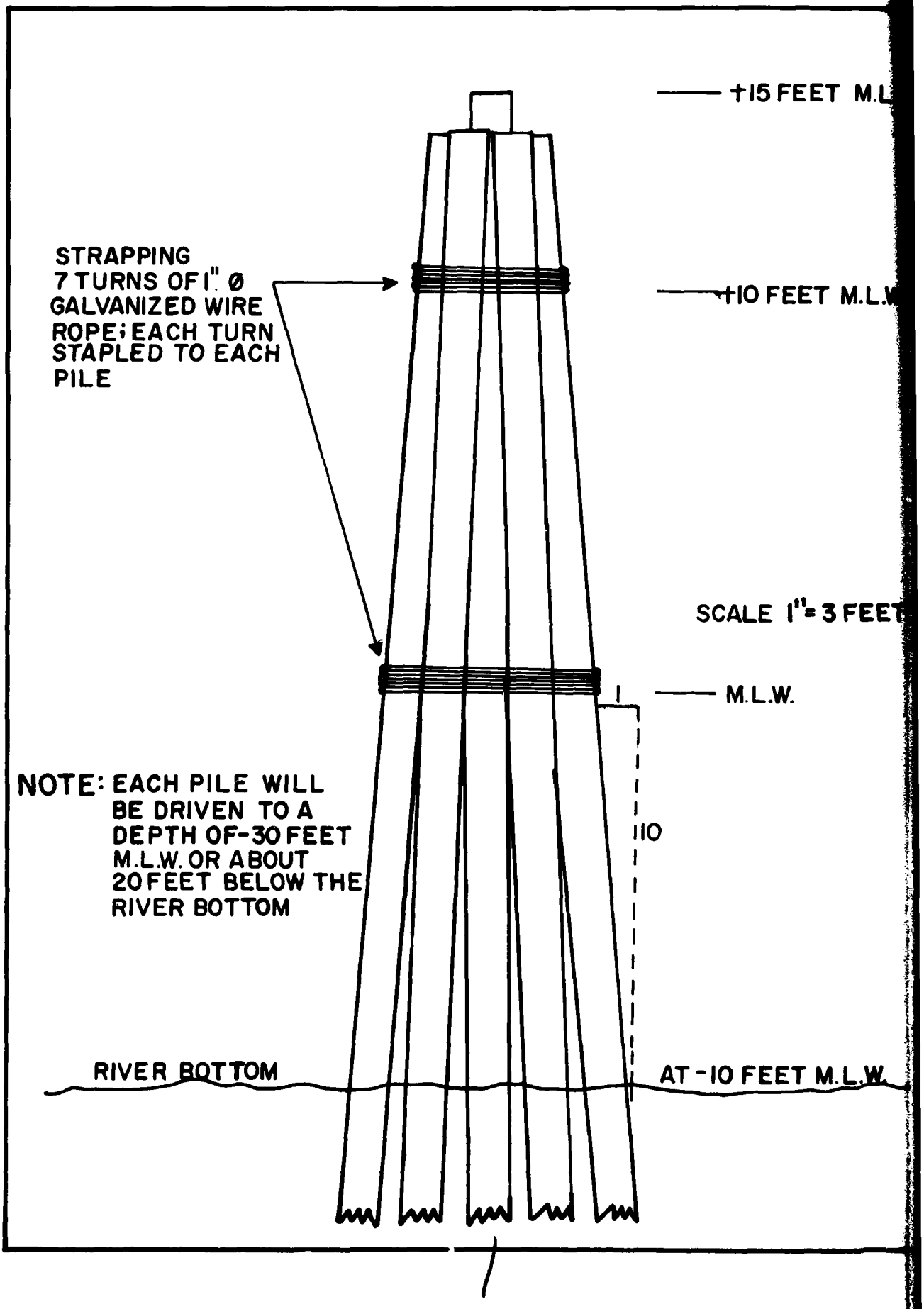
Area:

Boring No.: FD-9

Date: OCTOBER 1979

ENG FORM 1 MAY 63 2087

FIGURE 4-18

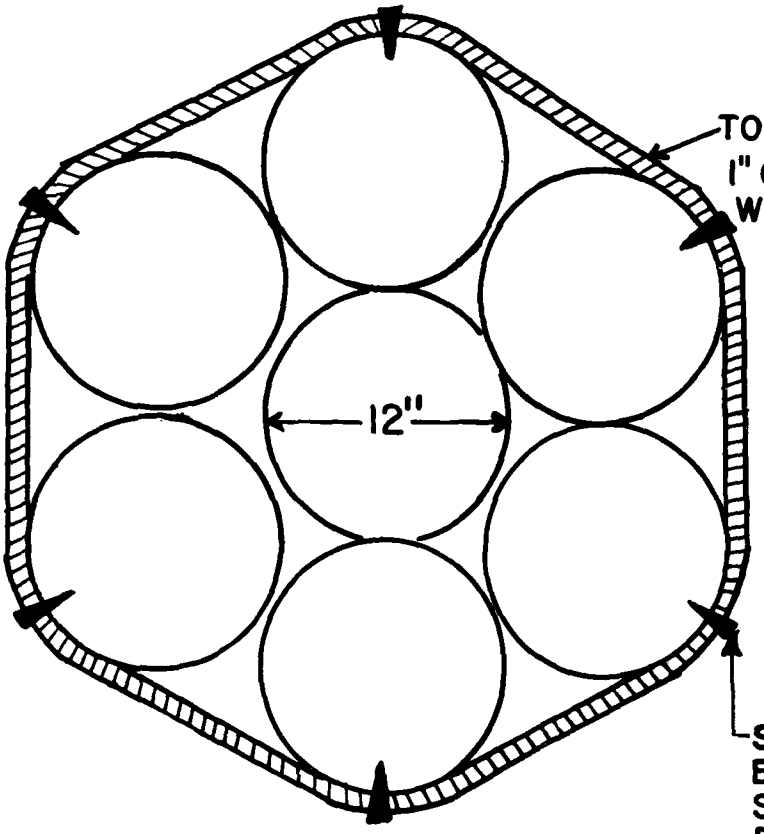

+15 FEET M.L
STRAPPING
7 TURNS OF 1" Ø
GALVANIZED WIRE
ROPE; EACH TURN
STAPLED TO EACH
PILE
+10 FEET M.L.W
SCALE 1" = 3 FEET
M.L.W.
NOTE: EACH PILE WILL
BE DRIVEN TO A
DEPTH OF -30 FEET
M.L.W. OR ABOUT
20 FEET BELOW THE
RIVER BOTTOM
110
RIVER BOTTOM
AT -10 FEET M.L.W.

EET M.L.W.

ET M.L.W.

3 FEET

.L.W.



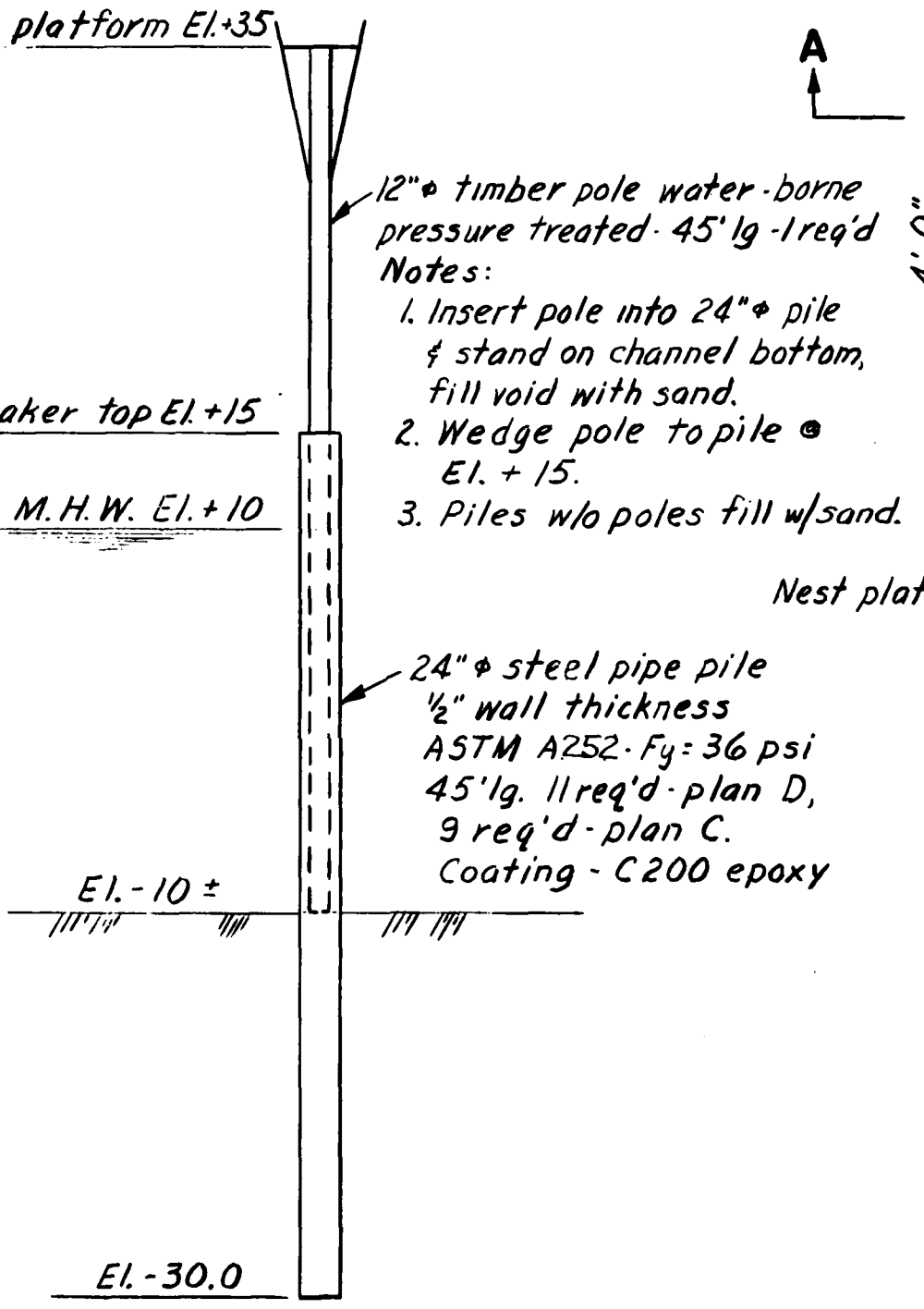
PLAN AT TOP

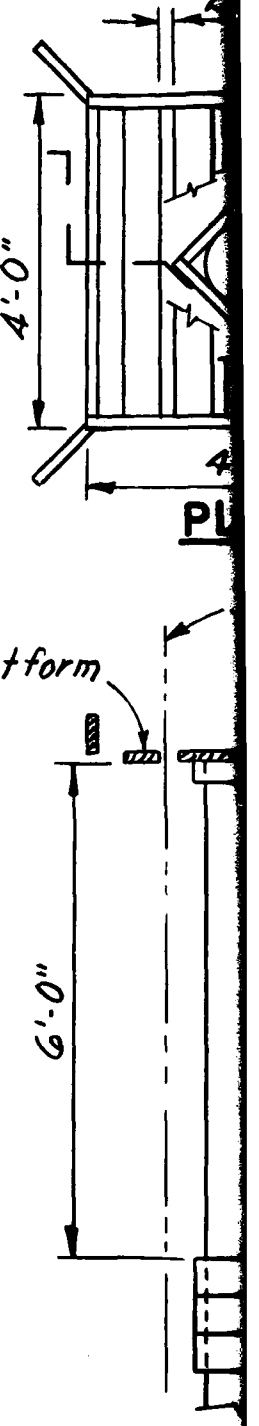
WOODEN PILE CLUSTER
7 PILES
EACH PILE 12" DIAMETER
45 FEET LONG, WATER
BORNE, PRESSURE TREATED
SCALE 1 INCH = 8 INCHES

WATER RESOURCES IMPROVEMENT STUDY
CAMP ELLIS HARBOR
SACO RIVER, SACO, MAINE
WOODEN PILE CLUSTER
ICEBREAKERS

FIGURE 4-19

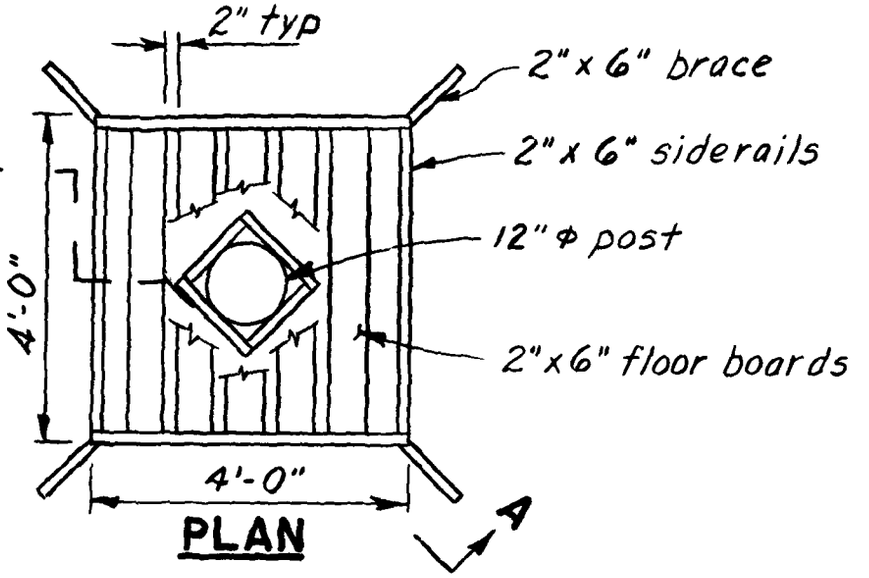
1 2



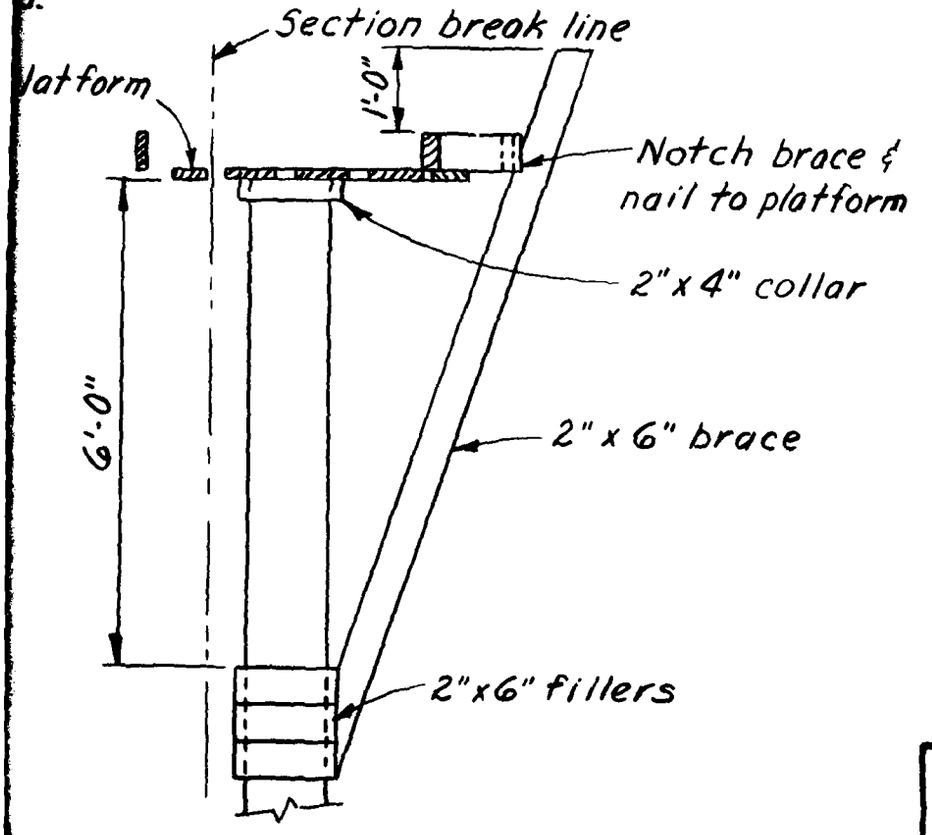


ELEVATION
(BREAKER AND PLATFORM)
SCALE: 1/8" = 1'-0"

SECTIO
(OSPREY NE
SCALE:



PLAN



SECTION A-A

(OSPREY NEST PLATFORM)

SCALE: 1/2"=1'-0"

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

SACO RIVER, CAMP ELLIS HARBOR

ICE BREAKER AND OSPREY NEST PLATFORM

SACO, MAINE

DATE: FEB. 1981

FIGURE 4-20

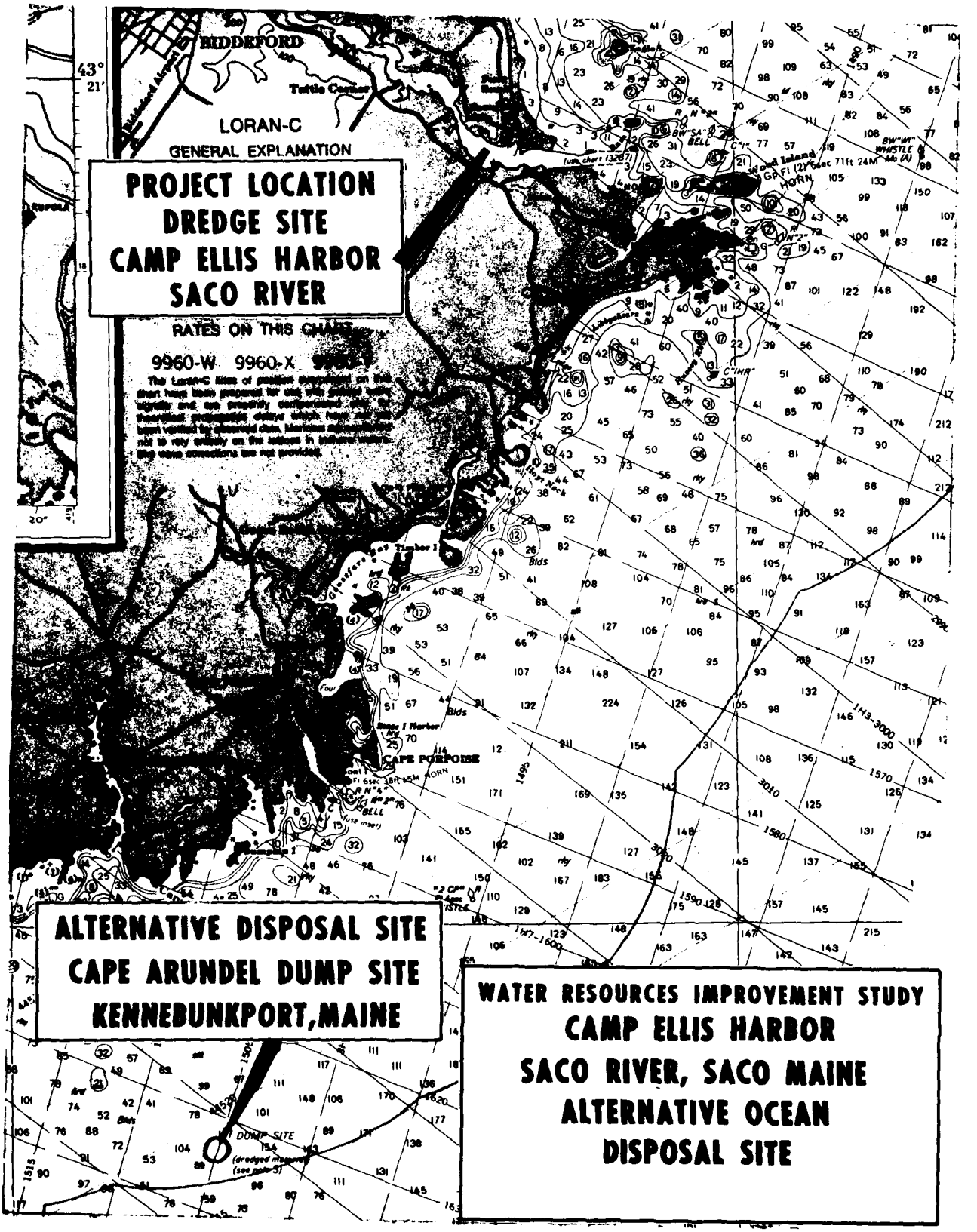
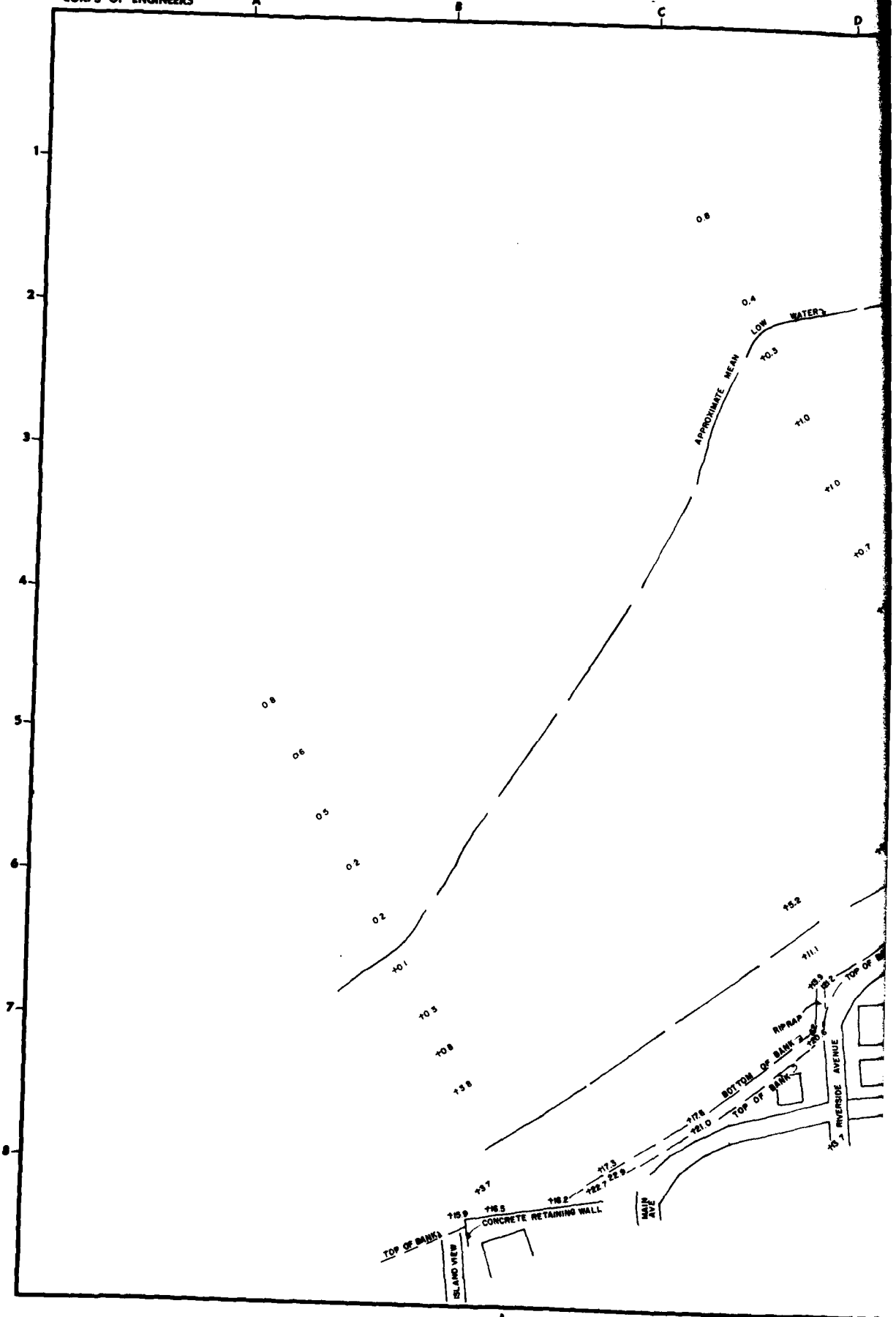
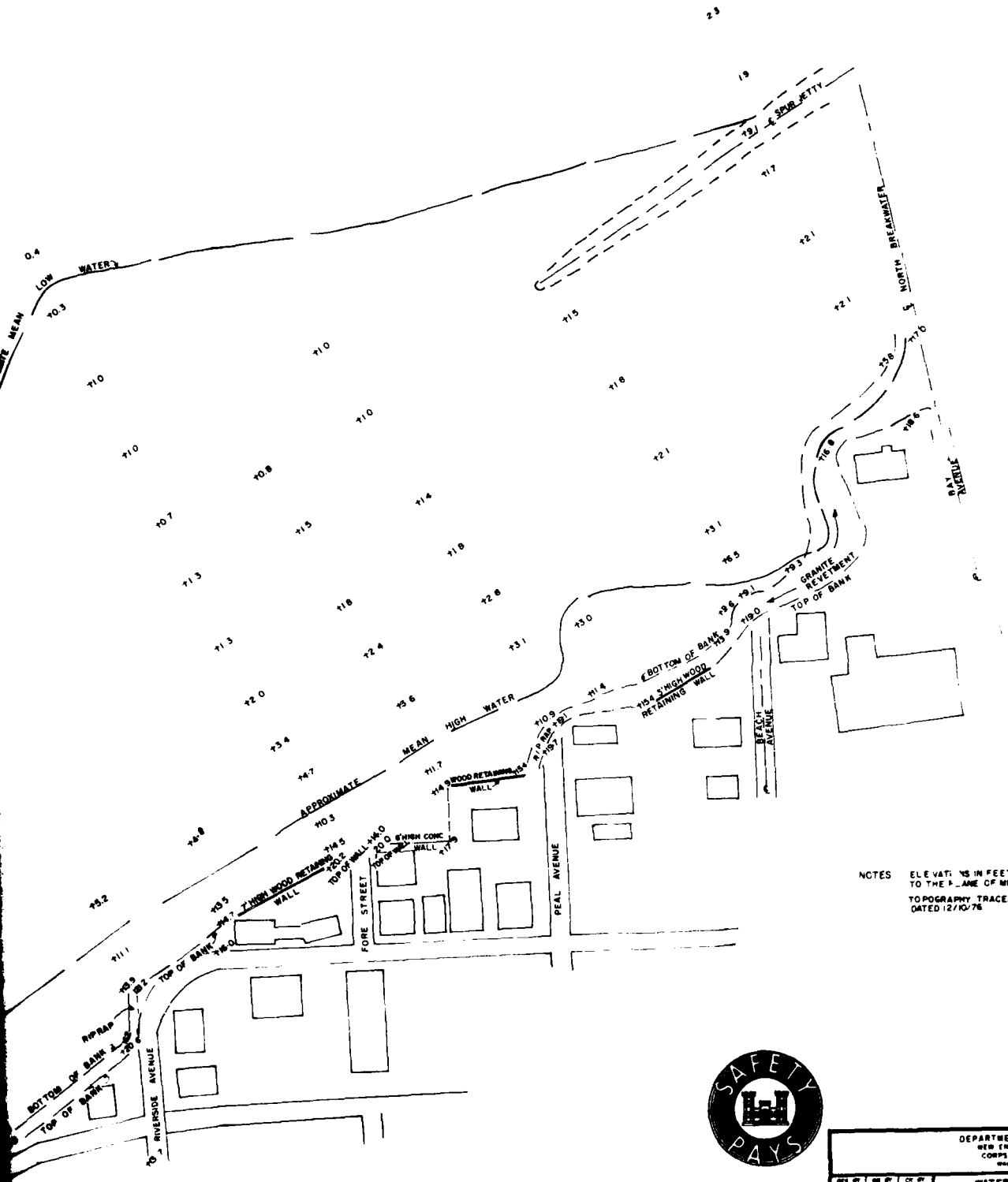

LORAN-C
GENERAL EXPLANATION
PROJECT LOCATION
DREDGE SITE
CAMP ELLIS HARBOR
SACO RIVER
RATES ON THIS CHART
9960-W 9960-X
ALTERNATIVE DISPOSAL SITE
CAPE ARUNDEL DUMP SITE
KENNEBUNKPORT, MAINE
WATER RESOURCES IMPROVEMENT STUDY
CAMP ELLIS HARBOR
SACO RIVER, SACO MAINE
ALTERNATIVE OCEAN
DISPOSAL SITE

FIGURE 4-21


CORPS OF ENGINEERS
A
B
C
D
1
2
3
4
5
6
7
8
APPROXIMATE MEAN LOW WATER
0.8
0.4
+0.3
+1.0
+1.0
+0.7
0.8
0.6
0.5
0.2
0.2
+0.1
+0.3
+0.8
+3.8
+5.2
+11.1
+5.9
+6.2
TOP OF
RIPRAP
+6.0
BOTTOM OF BANK
TOP OF BANK
+17.6
+21.0
RIVERSIDE AVENUE
+0.7
+17.3
+22.7
22.9
+3.7
+15.9
+16.5
+16.2
CONCRETE RETAINING WALL
MAIN AVE
TOP OF BANK
ISLAND VIEW



NOTES ELEVATIONS IN FEET AND TENTHS REFERRED TO THE PLANE OF MEAN LOW WATER

TOPOGRAPHY TRACED FROM SURVEY BY E C JORDAN CO INC DATED 12/10/76

SAFETY PAYS

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS

WATER RESOURCES IMPROVEMENT STUDY
CAMP ELLIS HARBOR
SACO RIVER, SACO, MAINE
RECOMMENDED DISPOSAL SITE
CAMP ELLIS BEACH
SACO, MAINE

DATE FEB 1978

FIGURE 4 22

1 2

CAMP ELLIS HARBOR
SACO RIVER
SACO, MAINE

DETAILED PROJECT REPORT

ECONOMIC ANALYSIS

APPENDIX 5

PREPARED BY

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

[redacted]

[redacted]

[redacted]

ECONOMICS APPENDIX
CAMP ELLIS HARBOR, SACO, MAINE

PROFILE-EXISTING CONDITIONS

The Saco River originates in the White Mountains of New Hampshire and flows southeasterly through Maine to a termination separating the cities of Saco and Biddeford on the Atlantic coast. The mouth of the river forms Camp Ellis Harbor, tidal and navigable for a distance of about 6 miles from the open sea and used extensively for commercial and recreational boating.

The city of Saco, located on the northern bank of the river, has experienced moderate population growth since 1960. In that year, the U.S. Census listed 10,515 residents, compared with 11,678 in 1970, an increase of approximately 11.0% in that decade. This growth greatly exceeded the corresponding increase for the State of Maine of 2.5% and was only slightly less than that of New England as a whole, 12.7%. The U.S. Census preliminary estimate of the 1980 population of Saco is 12,933, reflecting an increase over the most recent decade of 9.7%. This would indicate that the rate of population growth in Saco has decreased slightly, while the State of Maine grew much more rapidly for a total increase of 11.6% between 1970 and 1980. Future population projections predict a continuation of this moderate growth trend in Saco.

The relative economic condition of this growing population is difficult to assess because no extensive economic data is compiled in Saco on a regular basis. U.S. Department of Commerce estimates for per capita income in the city were $2,619 in 1969 and $2,765 in 1974, an increase of 43.8% in 5 years. These income level values compare favorably with those for the State in absolute dollar terms, $2,548 in year period for the State as a whole was slightly greater, 45.0%. In terms of real dollars, it is questionable whether the standard of living increased at all since the overall rate of inflation for that 5 year period totaled approximately 47.0%. More recent U.S. Census estimates of income levels are not yet available.

Another indicator of relative economic well-being in Saco is the number of residents living below the poverty level of income. Little change has occurred in this area over the 5 year period 1970-1975, during which the measure rose from 1,393 persons (12 percent of the population) to 1,414 persons (11 percent of the population). The State of Maine's average population living below the poverty level of income is approximately 8 percent.

Thus, while per capita income in Saco averages slightly higher than the State as a whole, the percentage of its population living in conditions of poverty is significantly greater than that of the State. This would suggest that there are significant numbers at each extreme end of the income ladder, many very poor and many quite well off.

Since the State of Maine does not publish employment by industry data at the town level on a regular basis, ascertaining an exact employment mix in Saco is difficult. Occupational categorization of the 4,619 members of the 1970 labor force is available through the U.S. Census, however. In that year, the number of employed residents totalled 4,498 or 97.3% of the labor force, resulting in an overall unemployment rate of only 2.7%. Estimation of monthly unemployment rates by city and town was recently initiated by the State of Maine. The average unemployment rate for the city of Saco in 1979 was 5.9%, with no significant seasonal fluctuations. Data available for the first six months of 1980 indicates that the unemployment rate has remained at the 5.9% average level.

The U.S. Census listed the major occupation in Saco in 1970 as operative (except transport), including 1,203 workers of which 1,103 were manufacturing industry operatives. With an additional 91 managers and administrators in manufacturing industries, a total of 1,194, or 25.8% of the labor force, derives its income from the manufacturing sector. Manufacturing, therefore, provides the economic base for the community.

Other major occupational groups in Saco are craftsmen, including mechanics and metal workers (15.6%); clerical workers (14.3%); and those additional categories shown in Table 1. Although the labor force has grown slightly since 1970, local officials believe little change has occurred in relative proportions of each occupational category.

It is also known that approximately 75 percent of all members of the Saco labor force are employed within York County, in which the city is located, and that the vast majority find employment in their own home city.

Much of the seasonal employment and income in Saco is associated with recreational and commercial activities at Camp Ellis Harbor. The public anchorage currently provides mooring for 75 boats, 45 are commercial fishing boats and 30 are recreational vessels. The demand which exists for additional mooring space at Camp Ellis Harbor was somewhat satisfied through the completion of a maintenance dredging project in late 1978 that returned the anchorage to its fully authorized boundaries. However, expansion of those boundaries would be necessary to satisfy the total excess demand.

The existing facilities consist of a municipal landing located almost at the mouth of the Saco River, with a 6-foot by 6 acre anchorage just upstream from the pier. An 8 to 9-foot dredged channel passes the pier and anchorage in the middle of the river, and is somewhat protected from the open sea by a 6,600-foot long breakwater on the north side of the river mouth and a 4,800-foot jetty extending from the south side parallel to the breakwater.

Table 1
EMPLOYMENT BY OCCUPATION IN SACO
1970

Occupation	Number	Percent of Labor Force
Operatives except transport	1,203	26.0
Manufacturing	1,103	23.9
Non-manufacturing	100	2.2
Craftsmen, foremen, and Kindred	721	15.6
Construction Craftsmen	174	3.8
Metal Craftsmen	128	2.8
Repairmen and Mechanics	112	2.4
Other Craftsmen	307	6.6
Clerical and Kindred	660	14.3
Professional, Technical, and Kindred	452	9.8
Managers and Administrators, non-farm	438	9.4
Manufacturing	91	2.0
Retail Trade	178	3.9
Other Industries	169	3.7
Service Workers	368	8.0
Sales (Wholesale and Retail)	250	5.4
Laborers (except farm)	212	4.6
Freight, Stock, and Material handlers	107	2.3
Construction	15	.3
Other Laborers	90	2.0
Transport Equipment Operatives	133	2.9
Farmers, Farm laborers, foremen, managers	32	.7
Household Workers	29	.6
TOTAL	4,498	97.3

Source: Compiled with U.S. Census data

The major commercial activity at Camp Ellis Harbor is lobstering, with an estimated 1980 landing total of 375,000 pounds valued at $750,000. An estimated 1,500,000 pounds of finfish, primarily haddock, cod, and pollock valued at $375,000 was reported by Camp Ellis fishermen. The peak lobstering season occurs in late summer and early fall, during the months of August, September, and October, and the low point during winter and early spring, January through April. Fishermen cite the migratory habits of lobsters as a major reason for the highly seasonal nature of the industry. Because lobsters migrate to deeper water during the winter months, additional travel time is necessary to reach the beds. Many lobstermen find these conditions unacceptable when coupled with the amount of time involved in breaking ice in the winter anchorage area before leaving the harbor and upon return from a day-long trip.

At the present time, the leading commercial activity at Camp Ellis Harbor during the winter months, December through March, becomes fin-fishing, which does not require as great a travel distance. The gross haul of fish does not approach its potential total however, because inadequate facilities in the harbor force most fishermen to haul their vessels ashore and remain idle, or relocate to nearby harbors, including Biddeford Pool, Cape Porpoise, Kennebunkport, Pine Point, or Portland. The near-termination of commercial activity at Camp Ellis is the result of extensive damage to vessels from large sheets of ice that form in the predominantly fresh water upstream, break away, and follow the current downstream into the anchorage site. Many of these ice floes weigh up to 200 tons and have been observed traveling through the anchorage in excess of 100 feet per minute, cutting deep into wooden vessels upon collision. During the winter of 1976-1977, only three vessels remained active in Camp Ellis Harbor, all of which suffered major structural damage. The following winter, 1977-1978, eight vessels remained active, one of which sank (resulting in an estimated loss to the owner of $2,500) and seven of which required an average of $250 in repairs in excess of the normal annual maintenance costs. The harbormaster maintains that six vessels are expected to remain active during a typical winter season, and that few, if any, escape structural damage.

During the peak summer and fall months, the 45 commercial vessels in the harbor provide approximately 75 full-time jobs and 15 part-time jobs. During a typical winter season, commercial fishing at Camp Ellis provides only about 18 full-time jobs. Many fishermen maintain a steady income flow by operating out of alternative ports, but many others find it financially disadvantageous to do so because of the additional costs involved in relocation.

Camp Ellis Harbor enjoys many natural locational benefits, with easy access to the open sea and a proximity to the finest and most frequently used lobster beds off the Maine coast. Local fishermen choose the harbor as their preferred anchorage site, despite the expected problems encountered in the winter season, because the travel distance to these prime fishing grounds is shorter than from any of the alternative anchorages. This is a particularly favorable asset during winter months when seas are characteristically rough and the air temperature generally well below freezing. The breakwater and jetty have provided adequate wave protection in the Saco River and continued maintenance dredging of the channel has allowed problem-free access regardless of tidal conditions. This latter advantage is one not shared by the nearest alternative anchorage at Biddeford Pool, where the entrance channel is almost unnavigable for larger vessels at low tide. Camp Ellis is also convenient to major regional wholesale distributors, which in turn find a ready market in local residents, tourists, restaurants, and retail stores all over the northeastern United States.

The final advantage cited by fishermen at Camp Ellis is the comparative low cost of operation. Since the anchorage is public, the only cost involved is for the utilization of the municipal pier and unloading crane, which is operational year-round. The current annual fee is $50.00 compared with $350.00 at Biddeford Pool, the nearest alternative. Most other ports along the southern Maine Coast charge by the weight of catch unloaded (1-2 cents per pound landed, depending on location and season of the year), which fishermen claim is significantly more expensive than the fee levied at Camp Ellis. Thus, even though they have already paid an annual fee, relocation forces most fishermen to expend even larger sums if they wish to operate for a full 12 months.

FUTURE CONDITIONS WITHOUT PROJECT

Requests submitted to the Corps of Engineers for improvements at Camp Ellis Harbor include the construction of protective devices around the anchorage area just downstream of the municipal pier to prevent ice damage to vessels during the cold winter months. If no protective action is undertaken, local fishermen and the harbormaster expect that future winter activity at Camp Ellis will continue on a scale similar to that of past years. Only a small percentage of the commercial fishing fleet would be expected to remain active from December through March; approximately three to six of forty-five vessels moored at the harbor during the summer would be expected to operate year-round, with the remainder choosing either to relocate to a nearby port or become inactive.

The anticipated economic effects of a continued annual decline in commercial activity during winter months at Camp Ellis Harbor include: the loss of potential income and the additional expense of hauling boats ashore for those fishermen who choose to become idle; the additional expenses involved in obtaining a new mooring, commuting to it, and traveling greater distances by sea to reach prime fishing grounds for those fishermen who choose to relocate; and additional costs of maintenance, repair of damages, and possible replacement of vessels for those who choose to remain at Camp Ellis year-round. The existence of these economic conditions in future winters would merely reflect the status quo, but local officials often express the fear that many fishermen will eventually relocate from Camp Ellis permanently to avoid the problems associated with ice floes in the Saco River.

ALTERNATIVES AND THEIR IMPACTS

Four major alternative plans for development of a safe anchorage at Camp Ellis Harbor have been proposed as follows:

Alternative "A" (Primarily Nonstructural Plan) - Placement of a series of 15 ice breaker structures to protect the north anchorage. The structures would be located at the western end of the anchorage with seven extending to the northwest and eight extending east along the anchorage boundary.

Alternative "B" - Construction of a rubble mound jetty beginning about 1,600 feet west of the town landing and extending about 700 feet in a south-southeasterly direction to the southwest corner of the north anchorage, then extending about 250 feet eastward along the south side of the north anchorage.

Alternative "C" - Construction of a new 3 acre anchorage area to the east of the existing town pier, requiring the dredging of approximately 9,400 cubic yards of clean sand. The anchorage would be protected by a series of 13 ice breaker structures.

Alternative "D" - Construction of a new 3 acre anchorage to the east of the existing town pier, located in such a manner as to be in the shadow of the pier to the maximum possible extent, receiving full benefit of whatever protection it offers. This would entail dredging approximately 12,500 cubic yards of clean sand. Placement of 11 ice breaker structures would also be necessary to protect the open southern boundary of the anchorage.

Of these four alternatives, Plans B has been eliminated from further consideration, due to failure of the design to meet planning goals and potentially significant negative impacts on the environment, respectively. (See Appendix 2 for discussion)

Project costs have been estimated for Plans A, C and D, and a computation of the potential benefits expected to accrue to each of the plans has also been completed utilizing the following information obtained through discussions with the Camp Ellis Harbormaster, local fishermen, and town officials:

1) After the protection project, a total of 16 vessels could be expected to remain in the harbor during the four winter months, six of which are normally moored at Camp Ellis, approximately five of which would normally become idle from December to March, and the remaining five from among those which usually relocate to other ports.

2) Fishing activity during those winter months would be primarily finfishing for reasons previously discussed. Although the number of active commercial vessels in the harbor is only a small percentage of the summer total and the winter season spans only about one-third of the year, an estimated 35 percent of the annual value of the finfish catch is landed during that period.

3) A fisherman's operating costs total approximately 40 percent of the value of his gross haul, with net income represented by the remaining 60 percent.

4) The cost of hauling a boat ashore and relaunching it in the spring is approximately $350, while "wet storage" of a vessel at a protected marina costs approximately $5.00 per foot, or $570 for an average size vessel at Camp Ellis Harbor. Approximately 50 percent of Camp Ellis fishermen who become inactive during winter choose either method of winter storage.

5) Approximately 15 minutes of additional sea travel time is added to each end of the day to reach the prime fishing banks off the southern Maine coast from two of the most frequently used alternative ports, Pine Point and Cape Porpoise, for a daily total of 1/2 hour.

6) An average fishing vessel burns about 10 gallons of diesel fuel per hour, at a current price of approximately $1.15 per gallon.

7) During the warm spring, summer, and fall months, fishermen work every day possible, often 6 or 7 days per week. During the cold winter months, fishermen only manage 2-3 days per week because of the amount of time the anchorage is clogged with ice floes that must be broken up. Fishermen expect that installation of ice breakers on the outer boundary of the new anchorage described by Plans C and D would gain them at least one additional fishing day per week during the December through March period.

The major benefit common to both Plans C and D is additional income expected for fishermen. The five new vessels that would normally be idle would be expected to gain income benefits, as well as the six vessels which currently remain at Camp Ellis Harbor in a typical winter. The five relocations mentioned would merely transfer income from alternative ports to Camp Ellis.

In 1980, the value of gross haul of finfish at Camp Ellis totalled approximately $375,000. Although the 4 months considered the "winter season" by local fishermen represent only a third of the fishing year, somewhat greater than a third of the annual value of the finfish catch is landed during that period. This is due to the fact that vessels remaining in the harbor concentrate more exclusively on groundfish during the winter, whereas most fishermen at Camp Ellis spend the warmer months lobstering. The price per pound is also significantly higher in the winter months because supply tends to be lower throughout the market. Since fishermen are able to fish out of Camp Ellis 2-3 days per week and claim an average trip lands 2000 pounds at an average per pound price of $.25, a typical vessel would gross approximately $20,000 over the 16 week winter period.

Fishermen predict, as previously mentioned, that creation of a protected anchorage would allow them at least an additional fishing trip each week during the winter. Thus the six vessels currently finfishing in a typical year could be expected to profit by an additional total of 96 trips, valued at $48,000.

The five additional vessels which would normally be idle during winter months would also be expected to fish an average of three to four trips per week over the 16 week period. Thus, a total of 280 additional trips would be added, with a total combined landing valued at $140,000.

The total additional gross haul that could be anticipated as a result of implementation of Plans C or D would be valued at $188,000. Since fishermen claim that operating expenses amount to approximately 40% of gross haul, the benefit which would accrue to fishermen in the form of additional net income would total $112,800.

Another substantial benefit common to both of the proposed protection alternatives is the elimination of the expense involved in boat hauling. This benefit would also accrue to those new vessels that would remain in the harbor year-round after completion of a project. Since the cost of hauling a boat ashore and relaunching it in the spring has been estimated at $460, the annual cost savings from the elimination of boat hauling would total $2,300.

Benefits would also accrue to those fishermen who would normally relocate to other ports during the winter. The elimination of additional fees for mooring and utilizing pier facilities would result in savings for those five boats forced to relocate in past years. The alternative ports most frequently utilized by Camp Ellis fishermen are Biddeford Pool, Cape Porpoise, and Pine Point, and occasionally Kennebunkport, Scarborough, and Portland. The annual fee of $350 at Biddeford Pool is not prorated for users on a monthly basis, and must be paid in full for the limited four month period, greatly increasing the yearly cost of anchorage for each Camp Ellis fisherman. Other harbors along the Maine coast charge by the quantity of fish landed at the pier at a current average rate of $.015 per pound, totaling approximately $1,200 per boat for the December through March period. Thus, the average annual total savings through the elimination of additional fees for anchorage space and unloading privileges at alternatives ports for all five relocations would be approximately $3,500, assuming three relocations from Biddeford Pool, the least expensive alternative, and two from other alternative ports.

This same group of fishermen would also be the beneficiary of the elimination of extra travel expenses and lost travel time, both in commuting from their homes to their vessels and from the anchorage to the prime fishing grounds in their vessels. The round-trip highway distance between Camp Ellis and Pine Point is 14 miles; between Camp Ellis and Biddeford Pool, 24 miles; and between Camp Ellis and Cape Porpoise, 35 miles. If it could reasonably be assumed that of the five relocations made unnecessary by a protection project, three would be from Biddeford, one from Cape Porpoise and one from Pine Point, an average of 24.2 round-trip miles per day would be prevented. Over a 4-month period, with 12 round-trips per week, a total of approximately 4,646 highway miles would be saved. At an average cost of 25 cents per mile for the pickup trucks generally used in the commute, the total cost of highway transportation to the alternative ports chosen by Camp Ellis fishermen is approximately $1,200.

Fishermen estimate that an additional 15 minutes at each end of the day is required to travel the distance by water from either Pine Point or Cape Porpoise to the fishing grounds of their choice than it takes to reach the same destination from Camp Ellis or Biddeford Pool, adding approximately 20 hours per boat over the entire four months. If two of the five prevented relocations were from Pine Point and Cape Porpoise, a total of 40 sea travel hours would be eliminated. With an estimated cost of fuel consumed in operating a fishing vessel of $10.00 per hour, a total of $400 savings in the cost of sea travel could be expected. A combined total savings of highway and sea travel expenses amounting to $1,600 could be expected as a result of a protection project at Camp Ellis.

Because fishermen are not employed on a hourly wage basis, no attempt has been made to assign a monetary value to the savings of total travel time, both by highway and water. It must be recognized, however, that the elimination of 200 hours of highway travel resulting from a 1/2-hour round trip to Pine Point, three 1-hour round trips to Biddeford Pool, and a 1-1/2 hour round trip to Cape Porpoise each fishing day, in addition to 40 hours of ocean travel would be a significant economic benefit resulting from a protection project.

A major benefit that could be expected to accrue to those fishermen who currently utilize Camp Ellis Harbor on a year-round basis would be the savings due to prevented damages. With an average additional cost of necessary maintenance and repairs due to ice damages totaling $250 per vessel for the six boats that remain in the harbor during a typical winter season, this benefit amounts to approximately $1,500 each year. Since the past losses resulting from sunken vessels are not taken into account by this estimate, it also may be considered as minimal.

Protecting the existing north anchorage from ice floes as proposed in Plan A would only increase the winter fishing season by 1 to 1-1/2 months due to the formation of sheet ice extending from the shoreline out into Camp Ellis Harbor in the area immediately upstream of the city pier. Historical observations indicate that this condition would be present for approximately 2-1/2 months of the 4 month winter fishing season. Since this allows only a 1 to 1-1/2 month increase in the fishing season instead of the full 4 month winter season to be realized under Plans C and D, the benefits to be realized under Plan A would be reduced accordingly.

Since fishermen are able to catch fish out of Camp Ellis 2-3 days per week and claim an average per pound price of $.25, a typical vessel would gross approximately $7,500 over the 6 week season provided by Plan A.

Fishermen predict, as previously mentioned, that creation of a protected anchorage would allow them at least an additional fishing trip each week during the winter. Thus the six vessels currently finfishing in a typical year could be expected to profit by an additional total of 36 trips, valued at $18,000.

The five additional vessels which would normally be idle during winter months would also be expected to fish an average of three to four trips per week over the 6 week period. Thus, a total of 105 additional trips would be added, with a total combined landing valued at $52,500.

The total additional gross haul which could be anticipated as a result of implementation of Plan A would be valued at $70,500. Since fishermen claim that operating expenses amount to approximately 40% of gross haul, the benefit which would accrue to fishermen in the form of additional net income would total $42,300.

Plan A would not provide boat hauling benefits as those additional vessels that would operate during the extending season would need to be haulded ashore or relocate once the winter anchorage iced over.

Some benefits would also accrue to those fishermen who would normally relocate to other ports during the winter. The partial elimination of additional fees for mooring and utilizing pier facilities would result in savings for those 5 boats forced to relocate in past years. The alternative ports most frequently utilized by Camp Ellis fishermen are Biddeford Pool, Cape Porpoise, and Pine Point, and occasionally Kennebunkport, Scarborough, and Portland. The annual fee of $350 at Biddeford Pool is not prorated for users on a monthly basis, and must be paid in full if fishing vessels anchor there once the Saco River anchorage ices over, increasing the yearly cost of anchorage for each Camp Ellis fisherman. Other harbors along the Maine coast charge by the quantity of fish landed at the pier at a current average rate of $.015 per pound, totaling approximately $750 per boat for the remaining 2-1/2 months of the winter season. Thus, the average annual total savings through the elimination of additional fees for unloading privileges at alternative ports for all relocations would be approximately $2,500, assuming three relocations from Biddeford Pool, at $350 per relocation the least expensive alternative, and two from other alternative ports.

This same group of fishermen would also be the beneficiary of the elimination of extra travel expenses and lost travel time, both in commuting from their homes to their vessels and from the anchorage to the prime fishing grounds in their vessels. The round-trip highway distance between Camp Ellis and Pine Point is 14 miles; between Camp Ellis and Biddeford Pool, 24 miles; and between Camp Ellis and Cape Porpoise, 35 miles. If it could reasonably be assumed that of the five relocations made unnecessary by a protection project, three would be from Biddeford, one from Cape Porpoise and one from Pine Point, an average of 24.2 round-trip miles per day would be prevented. Over a 6-week period, with 12 round-trips per week, a total of approximately 1,742 highway miles would be saved. At an average cost of 25 cents per mile for the pickup trucks generally used in the commute, the total cost of highway transportation to the alternative ports chosen by Camp Ellis fishermen is approximately $450.

Fishermen estimate that an additional 15 minutes at each end of the day is required to travel the distance by water from either Pine Point or Cape Porpoise to the fishing grounds of their choice than it takes to reach the same destination from Camp Ellis or Biddeford Pool, adding approximately 7.5 hours per boat over the six week period. If two of the five prevented relocations were from Pine Point and Cape Porpoise, a total of 13 sea travel hours would be eliminated. With an estimated cost of fuel consumed in operating a fishing vessel of $10.00 per hour, a total of $130 savings in the cost of sea travel could be expected. A combined total savings of highway and sea travel expenses amounting to approximately $600 could be expected as a result of a protection project at Camp Ellis.

SUMMARY

In summary, the annual benefits common to both of the alternative dredging plans (Plans C and D) for protection to the Camp Ellis Harbor anchorage area from ice floes are:

Additional revenues to fishermen (net income)	$112,800
Elimination of boat hauling	2,300
Elimination of extra fees	3,500
Elimination of extra travel expenses	1,600
Savings due to prevented damages	1,500
Total annual benefit	$121,700

Annual benefits associated with Plan A for protection to the existing north Federal anchorage at Camp Ellis Harbor from ice floes are:

Additional revenues to fishermen (net income)	$42,300
Reduction of extra fees	2,500
Reduction of extra travel expenses	600
Total annual benefit	$45,400

Preliminary cost estimates have been developed and annual costs calculated for a 50-year project life at an interest rate of 7-3/8%. These costs are displayed in Table 2. The benefit-cost ratios for Plans A, C, and D are calculated as follows:

BENEFIT-COST COMPARISON

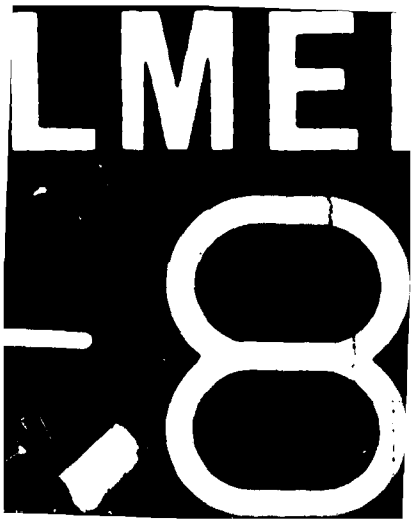
	Plan A	Plan C	Plan D
Annual Benefits	45,400	121,700	121,700
Annual Costs	12,200	29,000	33,300
Benefit-Cost Ratios	3.7	4.2	3.6
Excess Net Benefits	$33,200	$92,700	$88,400

As indicated by the Benefit-Cost ratios shown, all proposals are economically justifiable on the basis of at least a dollar return for each dollar invested. The selected plan for National Economic Development, identified as that plan for which benefits net of costs are maximal, is Plan C.

SENSITIVITY ANALYSIS

The following is an analysis of project costs based on an interest rate of 7-5/8 percent.

PLAN	A	B	C
TOTAL FIRST COST	$131,400	$237,700	$260,900
Annual Charges I&A (7-5/8%)	$10,300	$18,600	$20,400
Maintenance Dredging	-	$8,600	$11,300
Icebreaker Replacement (at yr. 25)	$1,600	$1,400	$1,200
Maintenance of Navigation Aids	$500	$1,000	$1,000
TOTAL ANNUAL COSTS	$12,400	$29,600	$33,900
ANNUAL BENEFITS	$45,400	$121,700	$121,700
BENEFIT-COST RATIOS	3.7	4.1	3.6
EXCESS NET BENEFITS	$33,000	$92,100	$87,800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